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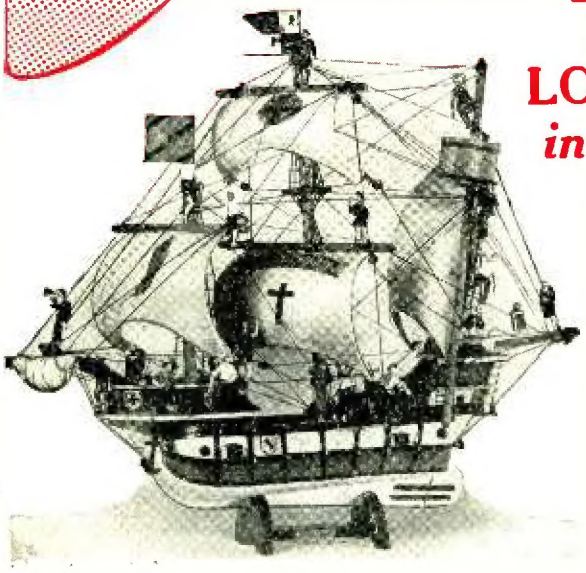

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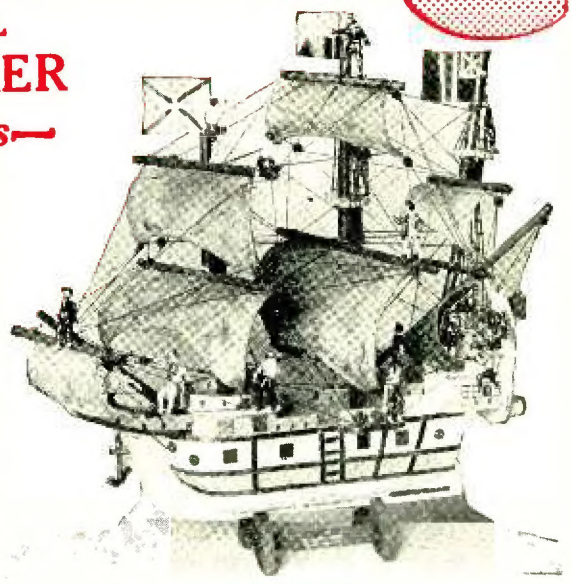

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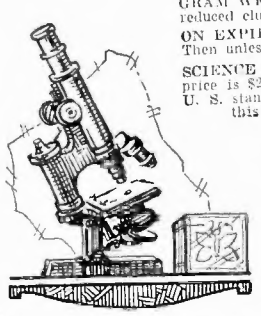

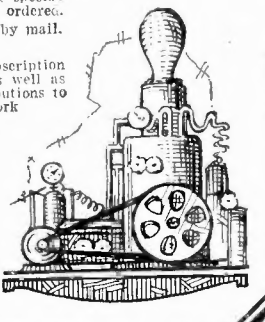

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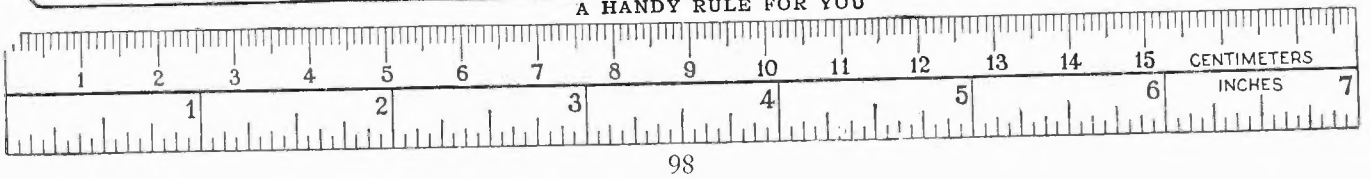

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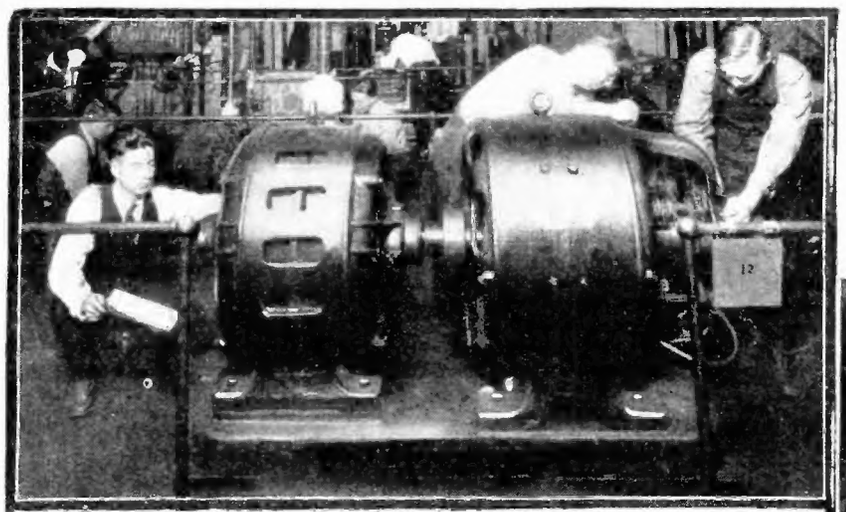

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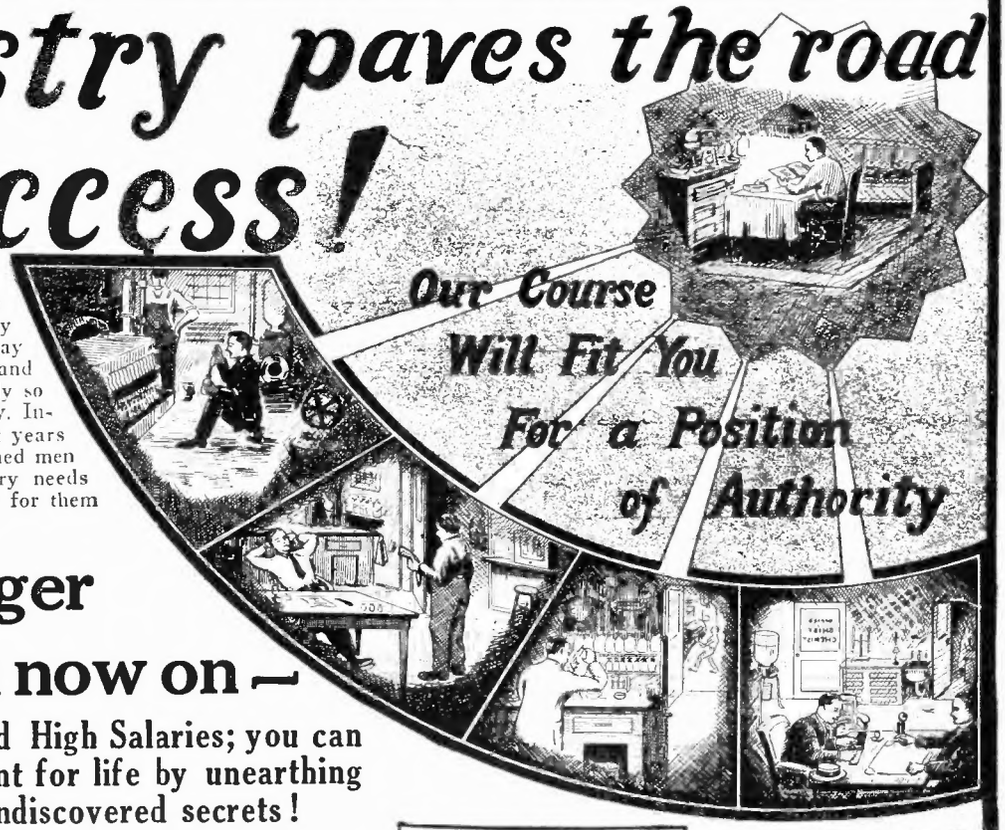

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JOHN WALTER.

I have not written since I received the big set. I can still say that it far exceeded my anticipations. Since I have been studying with your school I have been appointed chemist for the Scranton Coal Co., testing all the coal and ash by proximate analysis. The lessons are helping me wonderfully, and the interesting way in which they are written makes me wait patiently for each lesson.

MORLAIS COUZENS.

T. O'CONOR SLOANE, A.B., A.M., LL.D., Ph.D.

Noted Instructor, Lecturer and Author. Formerly Treasurer American Chemical Society and a practical chemist with many well known achievements to his credit. Not only has Dr. Sloane taught chemistry for years but he was for many years engaged in commercial chemistry work.

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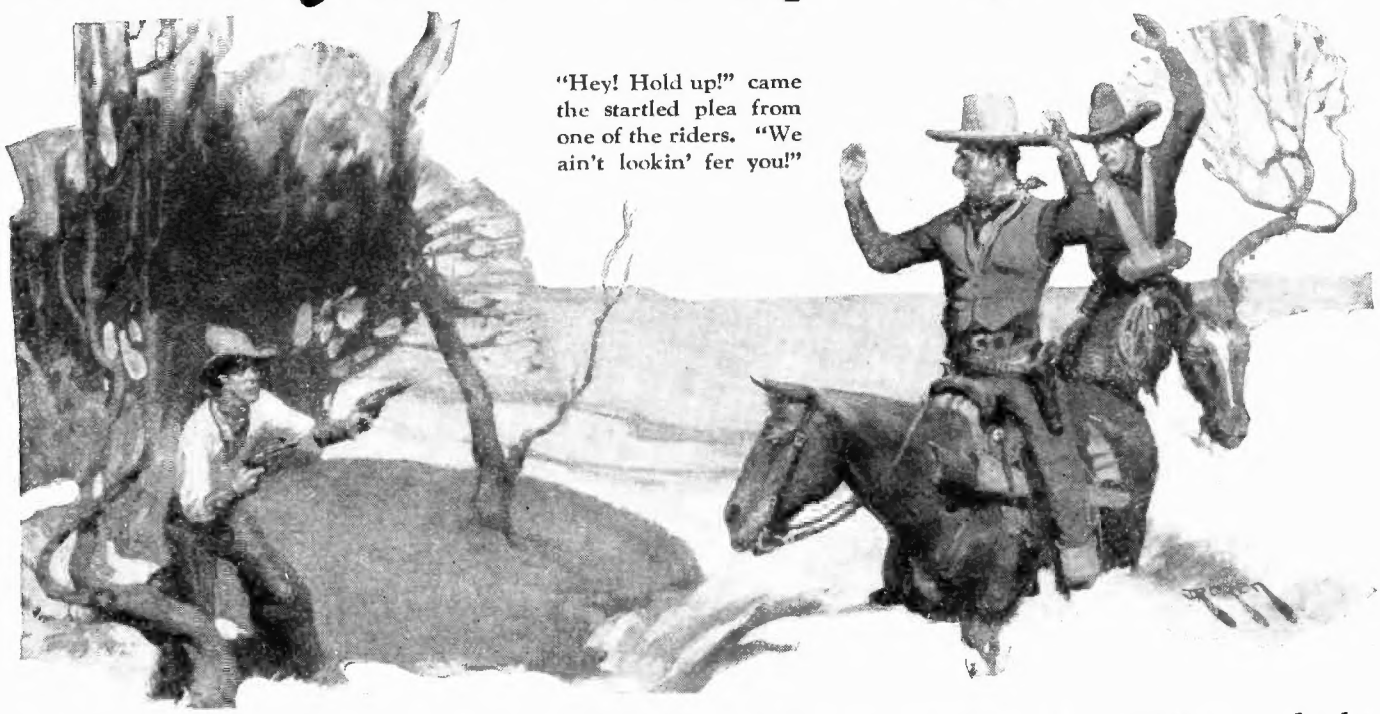
Cowboy Bristow Springs a Trap



"Hey! Hold up!" came the startled plea from one of the riders. "We ain't lookin' fer you!"

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Volume XV
Whole No. 170

Science and Invention

June, 1927
No. 2

HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
DR. T. O'CONOR SLOANE, Ph.D., *Associate Editor*
Editorial and General Offices, - - - 230 Fifth Avenue, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact" - - - HUXLEY

AFTER TELEVISION---WHAT?

By HUGO GERNSBACK

TELEVISION, which has been in the making for the last twenty-five years, and the perfecting of which has been freely predicted in many technical articles by many writers, as well as by myself, is now a reality. No longer need we look into the future for it. Although not perfected so that it can be attached to every telephone or to every radio set, television is, today, in a state comparable to that of radio when its principles were first laid down by Heinrich Hertz, in 1888, and to that of Bell's crude telephone, in 1876. It will take a few years to develop the television apparatus out of the laboratory stage, and much work as yet remains to be done. This is always the case when bringing the laboratory product to the final and practical everyday use with any instrument or technical appliance. It may take two years and even five years before every telephone and every radio set is finally equipped with its television attachment, but you may rest assured that this generation will soon personally witness the appearance of this stage of the art. There can be no doubt about it. But, and we may ask this question soberly,—"After television, what next?"

It is now possible to hear and see a person over a wire line, or over the radio. We have, therefore, made it possible to *transport two senses*, so to speak, to a distance, the two senses being sight and hearing.

In these days of wonder and achievement, we should ask ourselves the question, "What other of our senses is it possible to transport to a distance, and, from our present-day knowledge of science, is it possible to transport any of them at all?"

The remaining senses are smell, taste and touch. Now, then, of course nothing can be said to be impossible, although some things are highly improbable. Thus, the next of the senses on the list being smell, is it possible to smell at a distance? I might say that this is not impossible, although highly improbable. From a technical standpoint, it may be quite possible to build an instrument highly sensitive to odors, which instrument would be able to distinguish between the most subtle variations of various smells or odors. The next step would then be to amplify these, which presumably could be done by means of vacuum tube amplifiers. After that, transmission could be effected electrically by many ways now known.

At the receiving side the impulses would be stepped up and some means would have to be provided to unscramble the odors. We can imagine, for instance, 5,000 small tanks at the receiving end, each of which would release, upon a contact being made, an amount of odor depending upon how much was wanted, as indicated by the impressed signal. Thus it would be possible to *recreate* at the receiving end, odors or smells similar to those sent out from the transmitter. All perfectly possible, but, and here comes the big question mark, why would any one want to do it? It would cost a million dollars or more to build such an apparatus, and to what good? So I would say, "Not impossible, but highly improbable."

The next sense to be transmitted would be touch. Again I will say, "Not impossible, but somewhat improbable." It should be a simple thing to construct an electrical apparatus operated at a distance, to transport the sense of touch, in some ways. For instance, it is possible, today, to build an apparatus that, by means of television, would enable mechanical fingers to open the combination of a safe. You would watch by television a mechanical hand, of which you would operate a duplicate at the sending end, and you could thus open or close the combination of the safe without much trouble. This is not impossible, nor is it improbable, but, as with the transportation of the sense of smell, there would not be many uses for such a device.

We have with us today the science of *telemechanics*, which means, operating either by wire or by radio an apparatus at a distance. Some years ago, before television was invented, I described the radio-controlled television plane, which will make it possible, in a not-far-distant future, to operate an airplane without a human being on board, and which, being provided with television apparatus, will enable a distant operator to see and guide the plane over enemy territory and drop bombs at any desired instant, although no one be on board the airplane. We may call this "touch at a distance" and, in fact, it is just that. This is not only quite possible, but will be done in the next few years.

But, when it comes, for instance, to actually *feeling* the texture of a piece of cloth, at a distance of a thousand miles, this would seem to be highly improbable, at least for practical purposes.

The remaining sense, namely, taste, may be classed with the transportation of the sense of smell. It is not impossible, but highly improbable. A machine can be invented whereby, just like the one explained under odors, certain impressions are made upon certain media, when certain foods or liquids are placed upon it. The tongue, by dissolving certain of the ingredients of the foods or liquids, gives the sensation of taste. The counterpart of an electrical tongue would present no insurmountable difficulties to a clever physicist, and it is possible to transmit such impressions, in the form of electrical impulses, to a distance. Here, at the receiving apparatus, the impulses could release from tanks or some such other apparatus liquids to simulate the transmitted taste impulses. This is not impossible, but the whole thing would be the height of foolishness, because no one would want to do it, as the expense would be entirely too high.

It might be possible for a New York merchant in this way to taste the quality of Chinese tea 6,000 miles from New York, but why would he wish to do it after all? And certainly, if he had to pay the cost of doing it, he probably would think twice before attempting it.

Coming back to television, what application this interesting invention will take in the future can only be dimly guessed at. There was a time when we were talking first about radio telephony, when it was conceded by practically all of us who had a hand in the shaping of its destinies, that the logical thing would be talking by radio to our friends. Thus in the first book ever written on the subject: "The Wireless Telephone," published by me in 1908, before there was a Radiotelephone, I could see only one use for the coming invention and that was a parallel to the wire telephone. I did not dream of broadcasting, nor did any one else.

The same may be said of television. Right now we are glibly talking about television attachments on our telephones, and radio sets. We may be all wrong, and the new art of television may turn into entirely different directions, undreamt of today. Science has the habit of doing the unforseen, and often throws our best and most logical predictions on the scrap heap.

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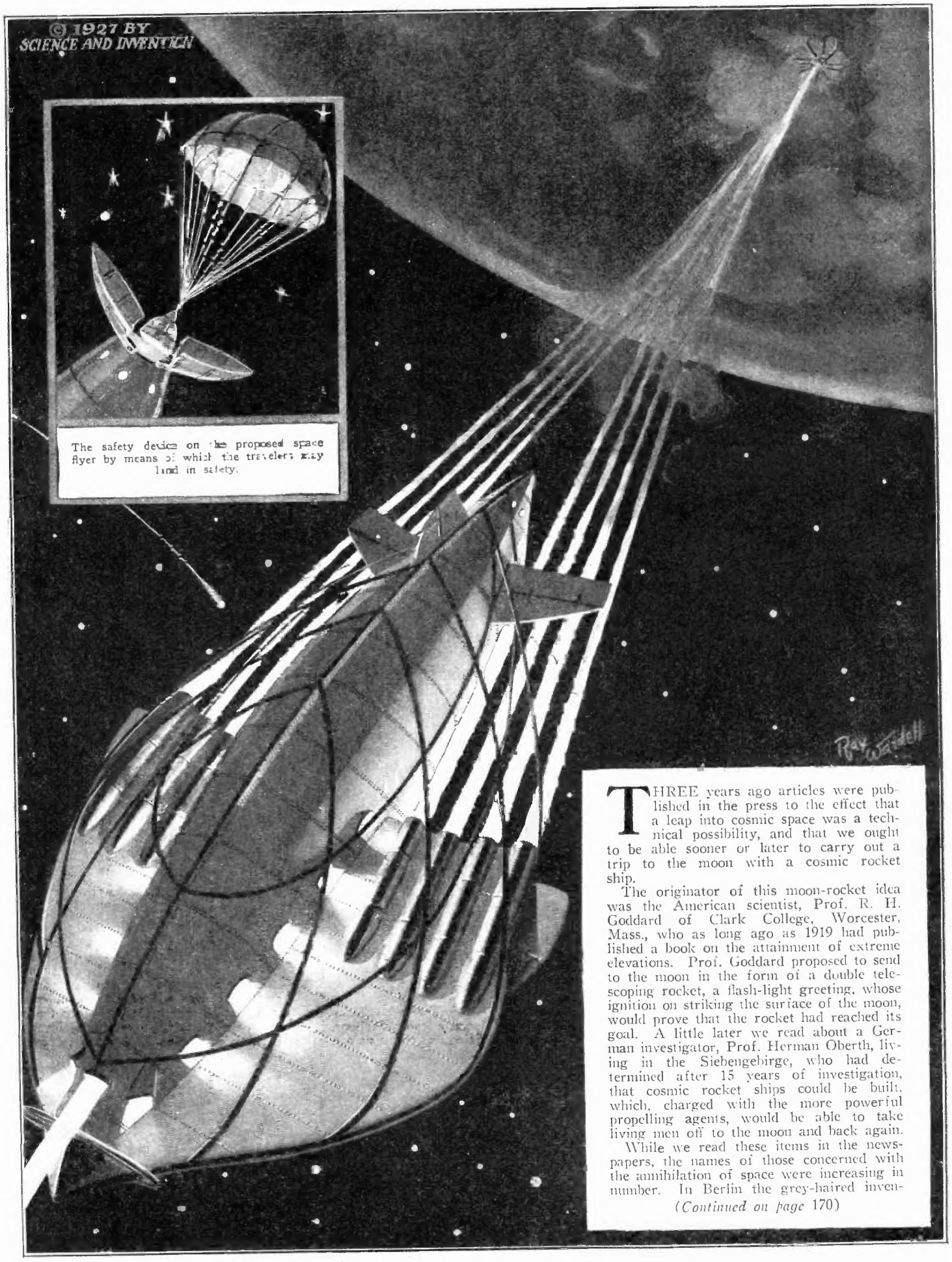
Can We Fly to the Planets?



The safety device on the proposed space flyer by means of which the travelers may land in safety.

THREE years ago articles were published in the press to the effect that a leap into cosmic space was a technical possibility, and that we ought to be able sooner or later to carry out a trip to the moon with a cosmic rocket ship.

The originator of this moon-rocket idea was the American scientist, Prof. R. H. Goddard of Clark College, Worcester, Mass., who as long ago as 1919 had published a book on the attainment of extreme elevations. Prof. Goddard proposed to send to the moon in the form of a double telescoping rocket, a flash-light greeting, whose ignition on striking the surface of the moon, would prove that the rocket had reached its goal. A little later we read about a German investigator, Prof. Herman Oberth, living in the Siebengebirge, who had determined after 15 years of investigation, that cosmic rocket ships could be built, which, charged with the more powerful propelling agents, would be able to take living men off to the moon and back again.

While we read these items in the newspapers, the names of those concerned with the annihilation of space were increasing in number. In Berlin the grey-haired inven-

(Continued on page 170)

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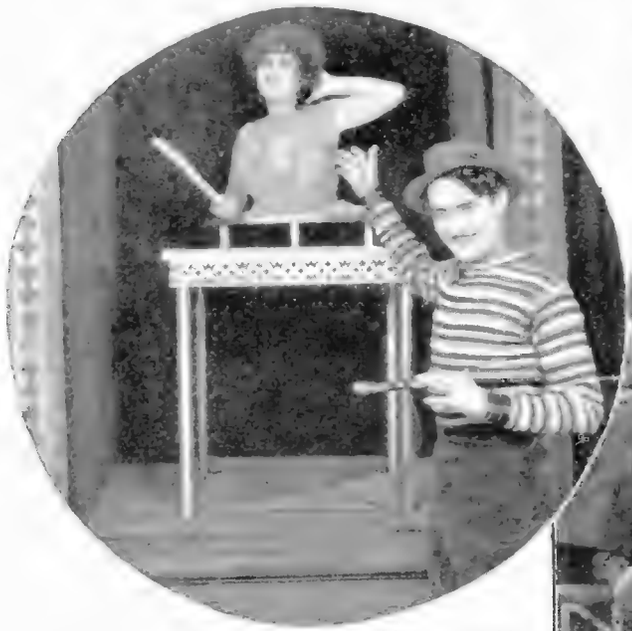
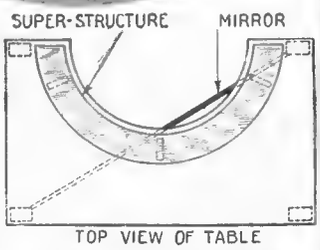
Movie Wonders Made With Mirrors

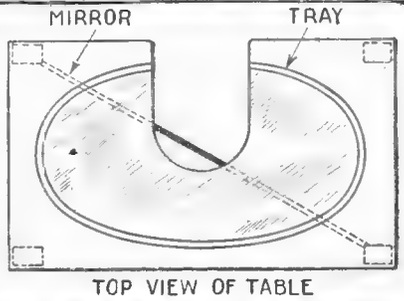
How a Little Science, Plus a Few Mirrors Properly Arranged, Can Mystify You Completely

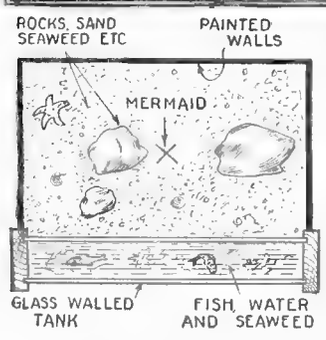


The "legless" woman has her legs hidden behind a mirror, which is placed diagonally between the left front and right rear legs of the table. The walls of the alcove are of black velvet. This gives the impression of there being nothing whatsoever under the table.



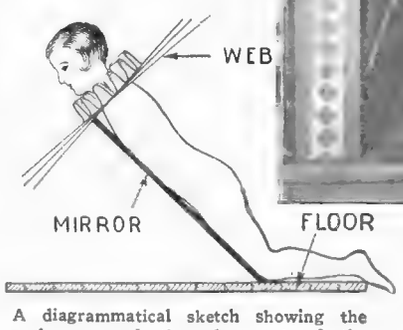
Again a mirror is used to deceive you. The owner of the apparently body-less head is merely seated on the floor behind a mirror, which is placed diagonally between the left rear and right front legs of the table. A notch is cut into the table top and the tray so that the head is placed in the center of the tray.



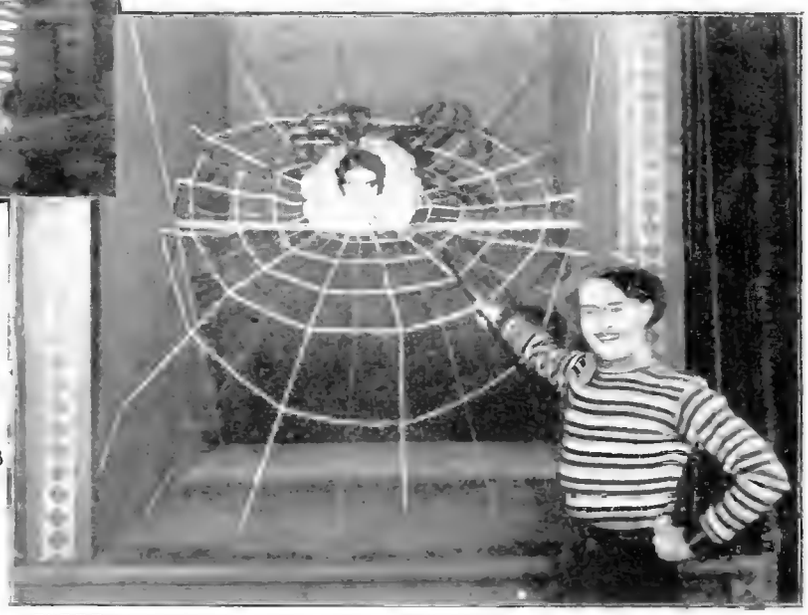


The diagram shows the location of the rocks, fishes, and scenery. The walls of the box in which the mermaid is seated are painted to represent marine scenery. The actress can apparently stay submerged for an indefinite length of time while going through the actions which may be required of her, without even experiencing the slightest discomfort.

Here we have a mermaid submerged for an indefinite length of time. She is in reality seated on perfectly dry rocks and sand. The water and fish are in a tank placed across the front of the box.



A diagrammatical sketch showing the performer and the placement of the mirror.



In this scene a huge spider has apparently caught the girl in his web. A mirror, leaning forward at an angle of 45° with its top edges hidden, reflects the bottom of the box. The girl is merely leaning forward against the mirror with her head thrust up through the web. This gives the appearance of a body-less woman resting in the meshes of a spider web. Again the mirror is used to trick us.

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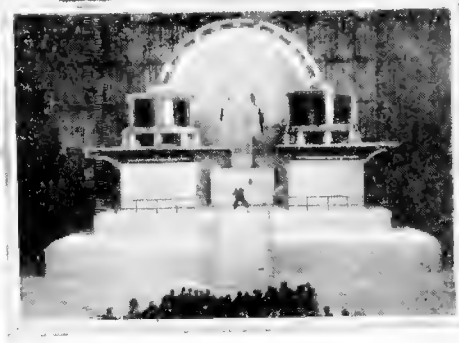
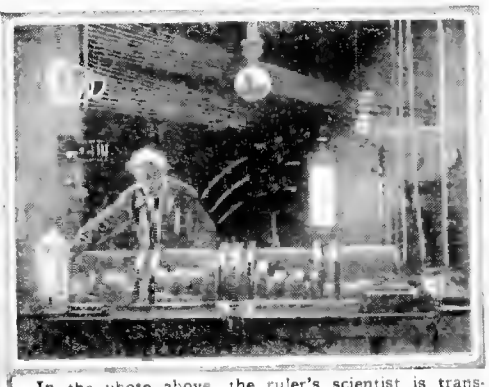
"METROPOLIS"—A MOVIE

The miniature set which was used in the filming of this remarkable motion picture. Toy trains and automobiles were pulled along the bridges by means of wires. The airplanes were suspended by a wire which was pulled by an operator outside of the set. At times full size lower stories were used, the image of the upper stories being reflected in a mirror to blend with them.

In "Metropolis," the city of the future, the lower classes are enslaved by the scientific and mechanical genius of the ruling group. Above is one of the laboratories in the "upper city." By invoking a diabolic discovery the ruler of the city was able to endow a manikin with human life and intelligence. This photoplay is reminiscent of our own "scientifiction" stories, which you all know.

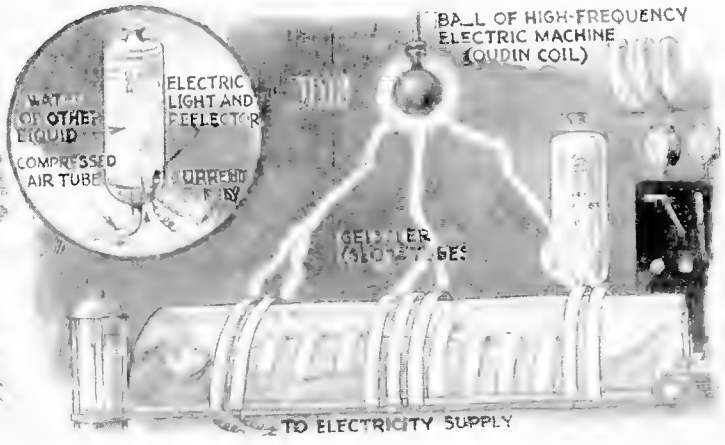




In the photo above, the ruler's scientist is transferring the vital spark from a girl of the lower city into his fiendish manikin, which he uses to spread disorder and destruction among the slaves. The sets used in this production are remarkable for their ingenuity and imaginativeness and the photography is unique.

—Photos courtesy Paramount Pictures.

The effect of sparks jumping about the machines was produced by placing a small high frequency apparatus near the camera as shown above. In the finished picture the sparks seemed to jump from the two huge coils placed on either side of the mechanism.



The spectacular scene in the scientist's laboratory. A weird effect was obtained by forcing compressed air through a closed tube containing a liquid and illuminated by a lamp placed at the bottom. Center photo shows one of the huge papier maché machines in the "power plant."

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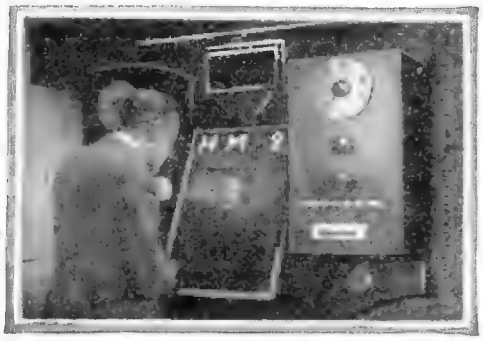
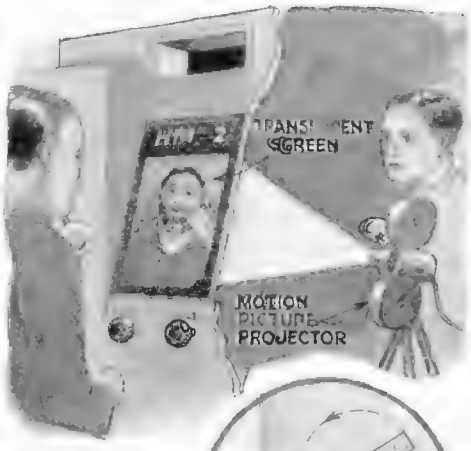
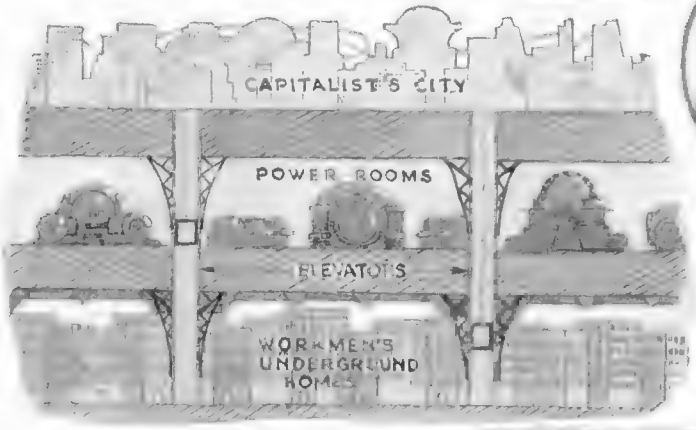
BASED ON SCIENCE

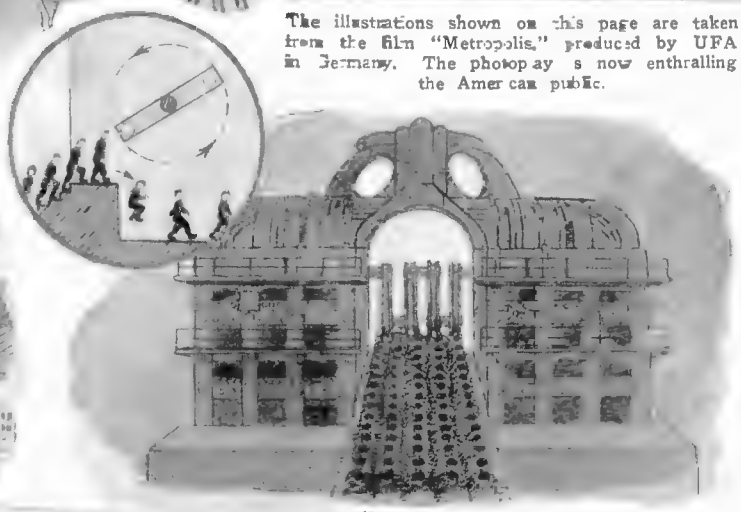


Of course the city of the future would have all the inventions of which we dream today. The recently perfected television apparatus, is in common use. By using it, those who converse may also at the same time see the other party.

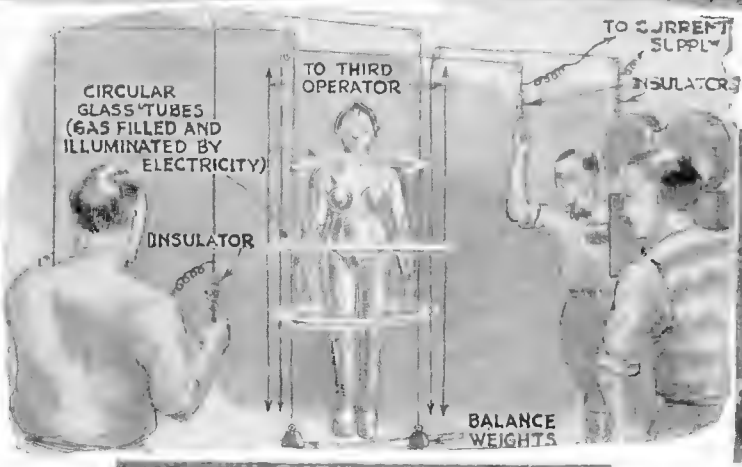


The illustrations shown on this page are taken from the film "Metropolis," produced by UFA in Germany. The photoplay is now enthralling the American public.

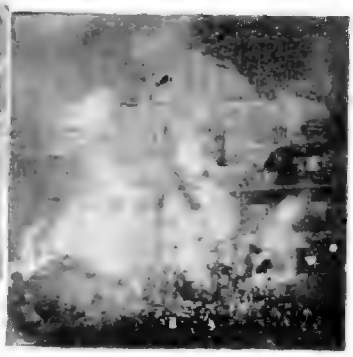




A sectional view of "Metropolis," the city of the future. Below may be seen mechanical woman possessing human life but no soul.



The maw of the huge machine which ruthlessly destroys body and soul. Below a picture of the huge machine at the time of its destruction.



Below: The workman's underground city. Note the shadowed effect.

The concentric rings of light which played about the marikin were hand operated.

Right: Destruction of "Workman's City." A small set was used and water, forced through pipes, was directed through the sides of the buildings and down from above. Pipes placed at street level ejected water in a geyser-like effect.

The destruction of the "Workmen's City" at the time of the flood. Note the appearance produced by the outstretched arms of the small children. In the center may be seen the immense gong which was used to sound alarm. Full size set used here.

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Television Perfected at Last

How the Living Image Is Transmitted and Reproduced Electrically

By H. WINFIELD SECOR

FOR the past twenty-five years experimenters and scientists have been working feverishly in their laboratories in an effort to solve the elusive problem of transmitting the living image of a person over an electric circuit, so that the person listening to a telephone conversation could see the face of the one to whom he or she was talking. Of course, there are innumerable other applications of television. On April 7th of this year, the engineers of the Bell Telephone Laboratories of New York City startled the scientific world by demonstrating a perfected television apparatus, which transmitted faithfully the likeness of Herbert Hoover and other celebrities speaking at Washington, the reconstructed image of the faces being flashed on a specially built glass screen at New York.

A distinguished company of invited guests, including the editors of all the well-known newspapers and magazines, witnessed the demonstration. The reproduced image was demonstrated both on a small scale, measuring about 2 by 2½ inches; and also on a large exhibition screen, measuring 2 ft. wide by 3 ft. high.

The accompanying photos and diagrams will help to make clear just what occurs in this remarkable system of transmitting the living image of a person over a telephone or radio circuit.

Referring to the diagram, Fig. 1, let us examine minutely for the moment the method used in picking up the object at the transmitting station, and starting the electrical impulses representing the face for example, over a telephone or a radio circuit.

One of the principal problems the engineers of the Bell Telephone Laboratories had to solve, was how to build a practically perfect synchronous motor unit for driving revolving disks both at the transmitter and receiver at identical speeds. These whirling disks rotate eighteen times every second, or 1080 revolutions per minute. Each contains 50 small perforations through which a pencil of light can pass, as each opening comes before the slit in the diaphragm, as becomes clear from inspection of Fig. 1. The powerful light from an electric arc, which is fitted with a suitable light-tight housing, is concentrated through a condensing lens on to the rear surface of the whirling disk. As each hole, 1, 2, 3, etc., comes into place before the diaphragm slit, a pencil of light leaps out on to the object to be transmitted, the human face, let us say, and further note that this pencil of light flashes across the face.

As there are 50 holes in the disk, there are 50 pencils of light flashing across the image every time the disk makes one revolution. As the disk rotates eighteen times every second, each target of light moves across the face eighteen times a second also. As each succeeding light beam coming from the disk perforations impinges on the object, there is a reflected beam which falls on one of three large photo-electric cells.

These photo-electric cells have the peculiar property of converting variations in light into very minute electric currents.

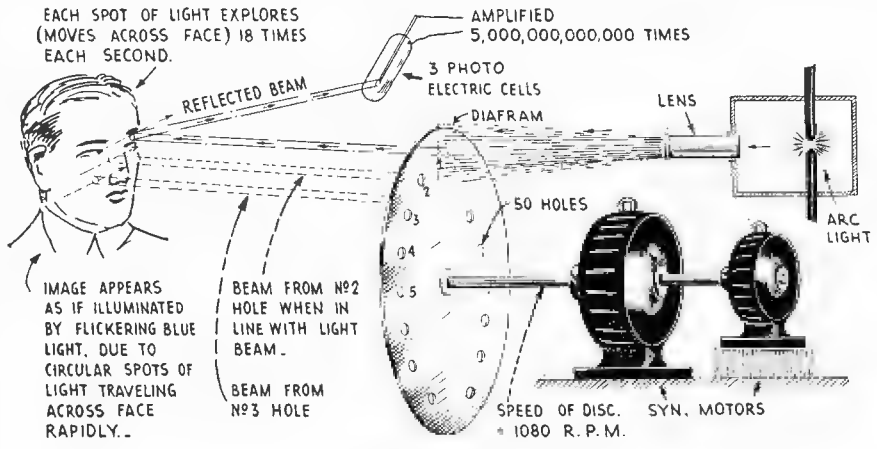
EACH SPOT OF LIGHT EXPLORES (MOVES ACROSS FACE) 18 TIMES EACH SECOND.
AMPLIFIED 5,000,000,000,000 TIMES
3 PHOTO ELECTRIC CELLS
REFLECTED BEAM
DIAFRAM
LENS
50 HOLES
ARC LIGHT
IMAGE APPEARS AS IF ILLUMINATED BY FLICKERING BLUE LIGHT, DUE TO CIRCULAR SPOTS OF LIGHT TRAVELING ACROSS FACE RAPIDLY.
BEAM FROM Nº2 HOLE WHEN IN LINE WITH LIGHT BEAM.
BEAM FROM Nº3 HOLE
SPEED OF DISC. 1080 R.P.M.
SYN. MOTORS

FIG. 1

At the transmitting end of the television circuit, the whirling perforated disk causes light beams of constantly changing angles to move across the face, the reflected light beams falling on one of three large photo-electric cells. These cells transform the constantly changing light beams into minute electric currents, which are amplified and transmitted to the receiver.

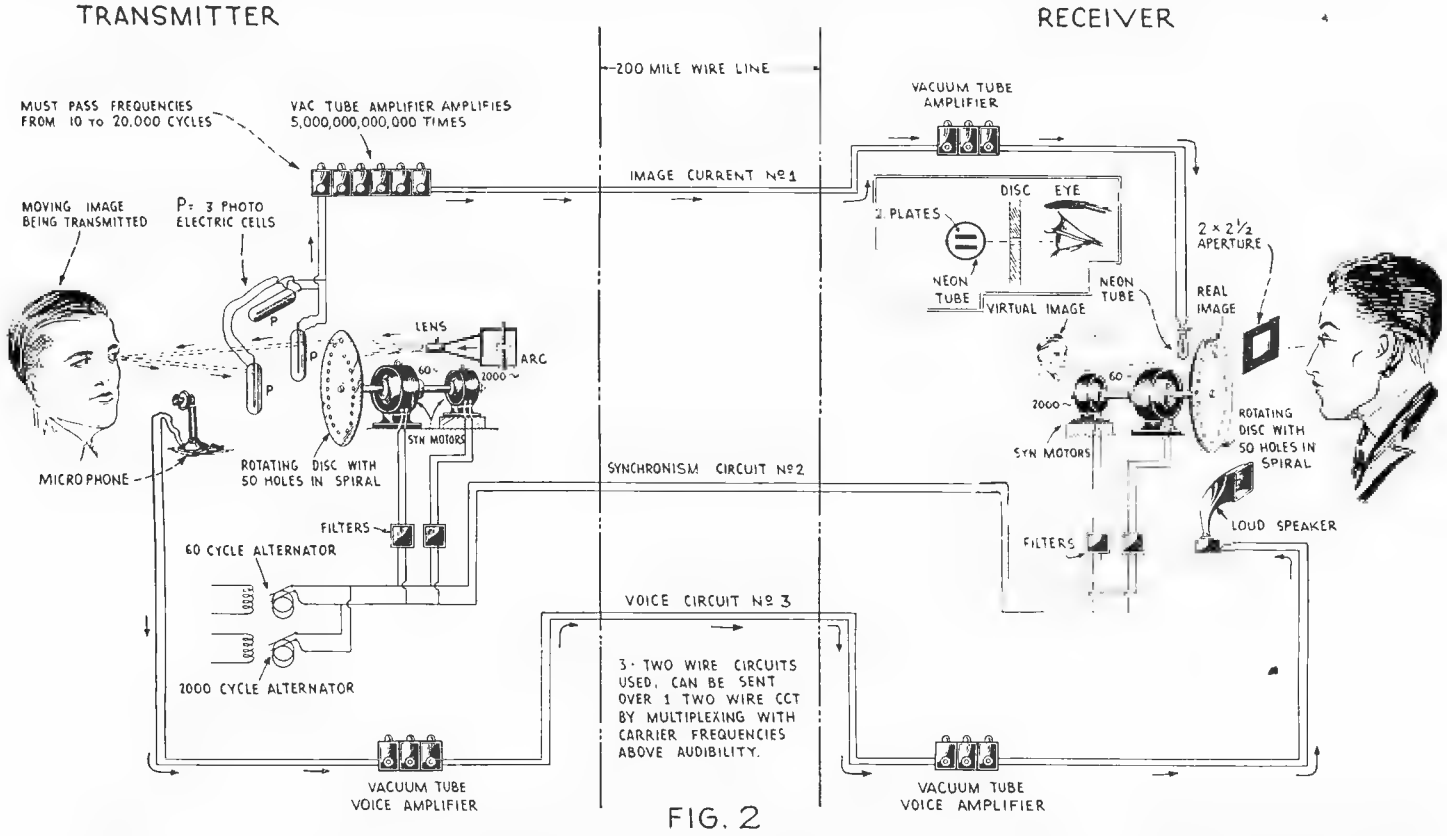

FIG. 2

A general lay-out of the wire transmission scheme for transmitting television images. The reflected light pulses from the face are suitably amplified, transmitted over a telephone or other circuit, again amplified and passed into a neon tube. The succeeding light pulses in the neon tube are viewed through the holes of a second whirling disk, driven by two synchronous motors. One of the weak points of previous television schemes has been the synchronism problem.

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Photo-electric cells have practically no inertia and respond instantly to every variation in a light beam thrown upon them. In other words, no matter how fast you play the light beams over the image to be transmitted, the photo-electric cell will follow you.

Looking closely at Fig. 1 again, it should be noted that the 50 pencils of light illuminating the face progressively in one revolution of the disk, do so in an orderly fashion; and the flashes of light, as they sweep across the object, line up one above the other, so that when the 50 light targets have swept across the object once, in progressive fashion, the whole surface of the object has been covered or explored. In the diagram Fig. 1, the light beams from No. 2 and 3 holes are shown separated, for the sake of clearness, but actually they touch and overlap slightly. The diameter of one of the light targets as it falls on the object is about one-fifth of an inch.

The minute electrical currents representing the light variations falling upon the three photo-electric cells, which cells are connected in parallel, by the way, so as to act as one large cell, are amplified about 5,000,000,000,000 times before they are transmitted over a telephone or other circuit.

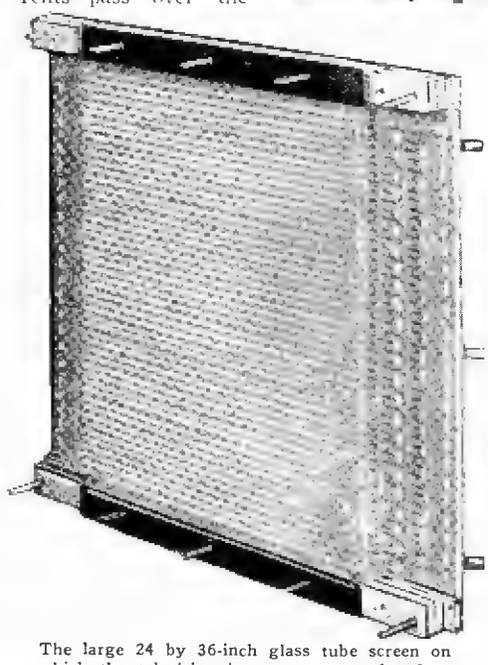
TRANSMISSION OF PICTURE IMAGE OVER LINE

LET us now take a look at the larger diagram, Fig. 2, which shows how the picture image currents are greatly magnified by a vacuum tube amplifier of several stages; also how the synchronizing current for the disk driving motors, as well as the voice current for the loud speaker at the receiving end, are transmitted over three circuits. Ordinarily four circuits would be required, but through a clever piece of engineering, the 60-cycle alternator and the 2,000-cycle alternator supplying the current to the 60-cycle and 2,000-cycle sychronous motors driving the two perforated disks, are fed in parallel to a common circuit as the diagram shows. Filters, containing suitable inductances, capacities and resistances, are inserted in each motor circuit, as indicated in the diagram.

A 60-cycle synchronous motor is not faithful enough in its maintenance of constant speed for such work as this, as these motors have a habit of *hunting*. This means that the motor speed may momentarily fall a little above or slightly below true synchronous speed. In twenty-four hours these gains and losses in speed will usually cancel out and leave the motor in synchronism at the end of the day, but with this perfected system of television, the speed must be maintained in an extraordinarily accurate manner. For this reason a second motor, operated at 2,000 cycles frequency, is mounted on the same shaft with the 60-cycle motor, and thanks to these two motors, the speed variation is so slight that it is negligible.

At right Mr. Walter S. Gifford, President of the American Telephone and Telegraph Company, speaking in front of the small television receiving screen.

The third telephone circuit used for carrying out this remarkable television scheme complete with voice; is shown clearly in Fig. 2. The usual microphone picks up the voice of the speaker at one end of the line, and the voice current pass through a vacuum tube amplifier of several stages. Thence the voice currents pass over the No. 3 telephone circuit, and as they enter the receiving station they are amplified again by means of another vacuum tube amplifier of several stages. The amplified voice currents then pass into a loud speaker, as shown in the picture.



The large 24 by 36-inch glass tube screen on which the television image was reproduced at the demonstration in the Bell Telephone Laboratories in New York City.

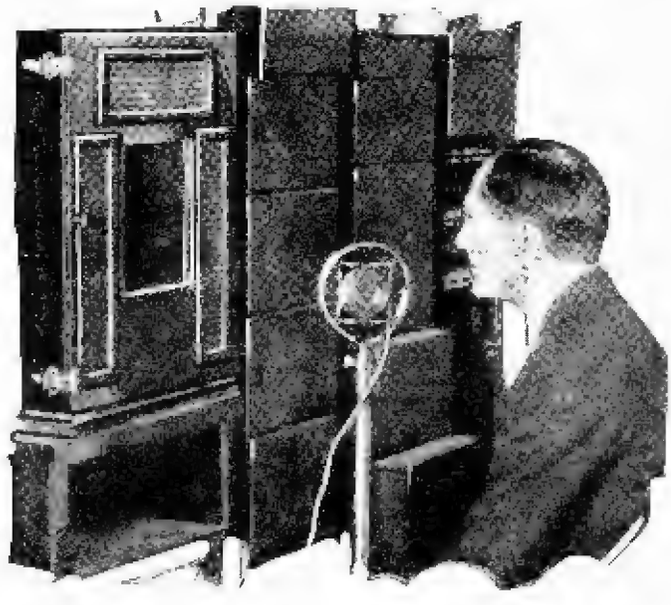


Photo at left shows subject at Television transmitter with microphone which picks up the voice. Behind the three grille doors are placed the large photo-electric cells, which pick up the reflected light images from subject's face, as the rapidly moving pencils of light coming out of the square opening shown explore it.

In the recent demonstration, whereby "seeing at a distance" was demonstrated by means of radio transmission and reception, the distance covered was about thirty miles between the Bell Telephone Laboratories' experimental station at Whippany, N. J., and New York City. Full details of the radio transmission are given in a specially prepared article in the June issue of *Radio News* Magazine.

Photos courtesy Bell Telephone Laboratories.

Three different wavelengths were used together with three independent and distinct radio transmitters; three separate receiving sets were employed.

When it comes to adapting this new perfected television scheme to our every-day requirements, the three telephone circuits here shown, can be simplified so as to require but one regular two-wire circuit. This can be accomplished quite simply by multiplexing the currents in the three circuits by utilizing the system worked out by telephone engineers some years ago.

REPRODUCTION OF IMAGE

LET us now consider how the living image of a person is reproduced at the receiving end of the line. As will be seen from the diagram, Fig. 2, a dual synchronous motor unit, comprising a 60-cycle and also a 2,000-cycle motor mounted on the same shaft, is used to rotate the perforated disk, this disk having the same number of holes as that at the transmitter end of the circuit. As this revolving disk with its 50 perforations whirls around behind the aperture plate, through which the eye looks at the image, as built up on a plane with the disk; light pulsations occur in the neon tube placed just behind the disk, these light pulsations occurring at the proper time and in perfect step with the arrival of the holes in the disk on a line between the neon tube and the eye. While the real image is seen at the surface of the disk, so to speak, the virtual image is some distance beyond it.

At the transmitter station it will be remembered that 50 spots of light traverse the object, such as the human face for example, eighteen times each second; in other words, 900 light targets explore the face at the transmitter every second. In consequence, the reproduced image at the receiving instrument is built up of 900 light targets per second, thanks to the perfectly synchronized whirling disk, the neon tube behind it, and the aperture through which the image is viewed.

Next comes the large glass screen measuring 2 ft. wide by 3 ft. high on which the living image was built up, so that the audience could see it clearly. This large screen represented a gigantic problem, and the way it was operated was as follows:

A continuous length of glass tubing was bent to form a grid having a surface meas-

(*Continued on page* 177)

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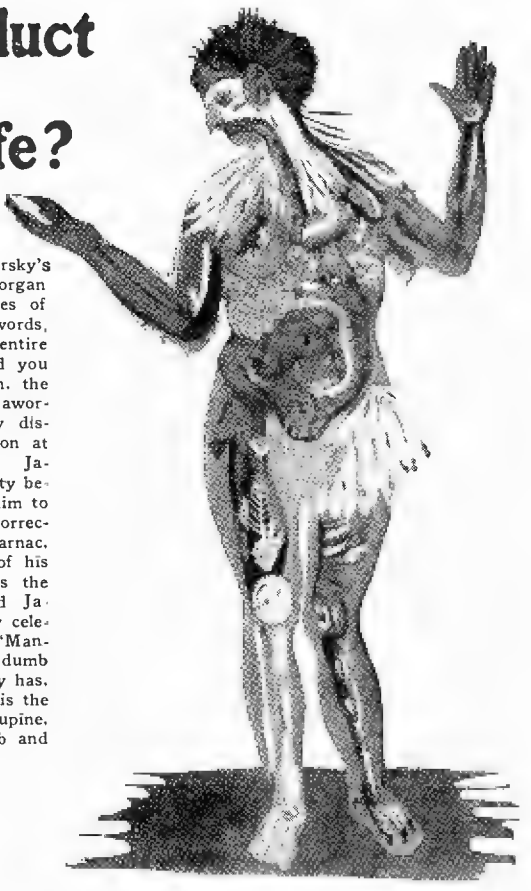
Is Man A Product of All Animal Life?

By UTHAI VINCENT WILCOX



The "Man-Menagerie" illustrates Dr. Jaworsky's revolutionizing discovery that each human organ is the equivalent in function to some species of animal life so that, in Jaworsky's own words, "man is a miniature reproduction of the entire history of evolution." Study the picture and you will see the hand representing the crustacean, the intestinal tract the reptile, et cetera. Dr. Jaworsky's biological researches have been widely discussed and these have also been written upon at unusual length in the "Courrier Medical." Jaworsky's recognition of the functional similarity between the bird and the human lung enabled him to actually make a serum from birds for the correction of respiratory troubles. Mme. Jane Marnac, the popular French actress, represents one of his most successful "bird-serum" cures. It was the principle of the "Man-Menagerie" that led Jaworsky to the discovery of the new, and now celebrated rejuvenation treatment. Jaworsky's "Man-Menagerie," as he calls it, is composed of dumb animals and insects. Each organ in the body has, he holds, its prototype in Nature. The nose is the beak of a bird, the hair the quills of a porcupine, the ear a shell, the hand the claw of a crab and the alimentary canal a serpent.

DR. HELAN JAWORSKY of Paris has been receiving high honors and accomplished remarkable results in his studies of mankind. The Academy of Science have recently recognized his theories. Dr. Jaworsky had constructed a biological tree in support of his claim that man's descent cannot be traced to apes, but instead to an original *life-cell*. He represents the evolution of the *same* cells that held the life-germ of all other animals. He further claims that not the ape alone, but all animals in type and more particularly in function, are represented in the human body.

Life, according to this eminent scientist, is a series of movements, varying only in length and quality. Thus the jerk of the kangaroo's jump is represented, functionally, in Man's breathing. The sinuous movements of the snake, again, are represented in many by the intestines. Bone formations, in his view, have kept their relationship with animals and lower forms of life as indicated by jointure and construction, and so even the fish has its counterpart in Man.

In the biological tree which Dr. Jaworsky has conceived as being fundamental truth, various species could be substituted for those which he has shown. The animals which he shows in his drawings are only those that indicate what he calls a biological principle.

One of his drawings relating to the functions of man to those of other forms of life—as, for example, one wherein he demonstrates that birds, like kangeroos, in their entire entity, function almost completely on the lines of the human lung. From this he argues that the kangaroo and the bird originally belonged to or grew from one species of *life-cell*, conditions being responsible for the division of the species. His investigations have led him to conclude that a further division took place when Man evolved, but that the cell-function was still reproduced in this new form of life, but, without changing its character, became only a highly specialized function amalgamated with other functioning cells, in a higher developed creature.

Sir Jagadis Bose, M.A., D.Sc., F.R.S., the great Indian scientist, from another angle has given most interesting scientific corroboration to the principle of the unity of life and the harmony of function, by his discoveries that all growing things in Nature have similar mechanisms to those of Man—that there is, for example, a nervous system in plants, a system of sap-circulation and actual nerve-impulses and responses to stimuli—as demonstrated by plants suffering from shock, or responding to tonic influences by increased vigor.

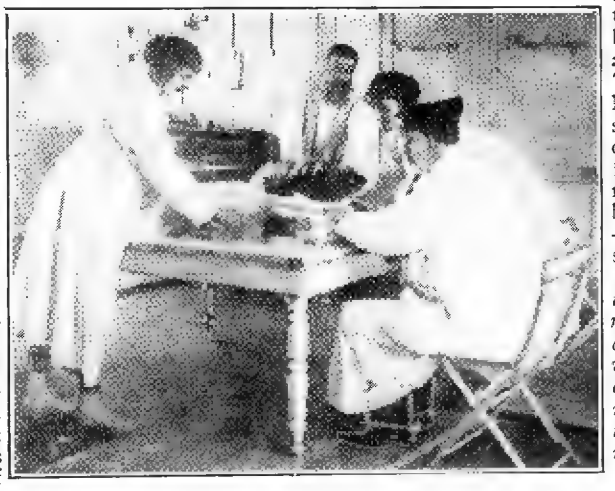
Dr. Jaworsky's drawings put into concrete form the evolutionary adaption of movement or functioning and show scientifically the development of functioning, bringing out the principle that no function has ever been lost but that it has been incorporated in the better developed type of living creature, Man.

"Biology," says Dr. Jaworsky in explanation of his principles, "brings to light the actions, more scientifically termed 'functions,' of every living thing. Study biology, understand it—and Man becomes nothing more, physically, than the problems of each species, but in the aggregate. It has long been known that serums can be made from the blood of various animals to react beneficially on human beings. I need seek no further for an instance than in the antitoxin used in the treatment of diphtheria. I go so far as to say that in time we shall find in each species of animal a cure for most ills.

"Through studying birds, I have found their functions duplicated in Man, or rather, to be exact, practically the entire functioning of a bird is concentrated simply into man's lung. I have demonstrated the usefulness of this knowledge by making from birds a serum which has cured numerous cases of pneumonia, asthma, bronchitis, hay fever and other respiratory ills.

"Our knowledge of the functions of animals, as yet, is very limited, I regret to say. There are many species of animal whose peculiar functions are so little understood by us that we cannot yet identify these with their prototypes in Man. But, that, after all, is a question of further research by enlightened scientists who even now, are investigating from every standpoint. The animal world and the vegetable kingdom too, can be described as a series of functions. Man is simply a completion and modification of these functions. Therefore Man—for the moment at least—may be the uppermost branch of the biological tree—is, indeed—but still he remains only a biological step in progress."

While Dr. Jaworsky's discovery seems to be gaining many friends, it does not necessarily follow that all his statements are correct. For instance, many of us would rather believe that the breathing of a kangaroo is similar functionally to man's breathing. We do not infer that the jerk of the kangaroo's jump is represented functionally in man's breathing. While we have given this theory of Dr. Jaworsky's space in this publication, it is not to be implied that the editors of SCIENCE & INVENTION *Magazine agree with all of Dr. Jaworsky's theories.*



For years the scientist Jaworsky experimented in his laboratory with dumb animals in an effort to find a way to overcome "fatigue poison," and now he is acclaimed a rejuvenator of human beings.

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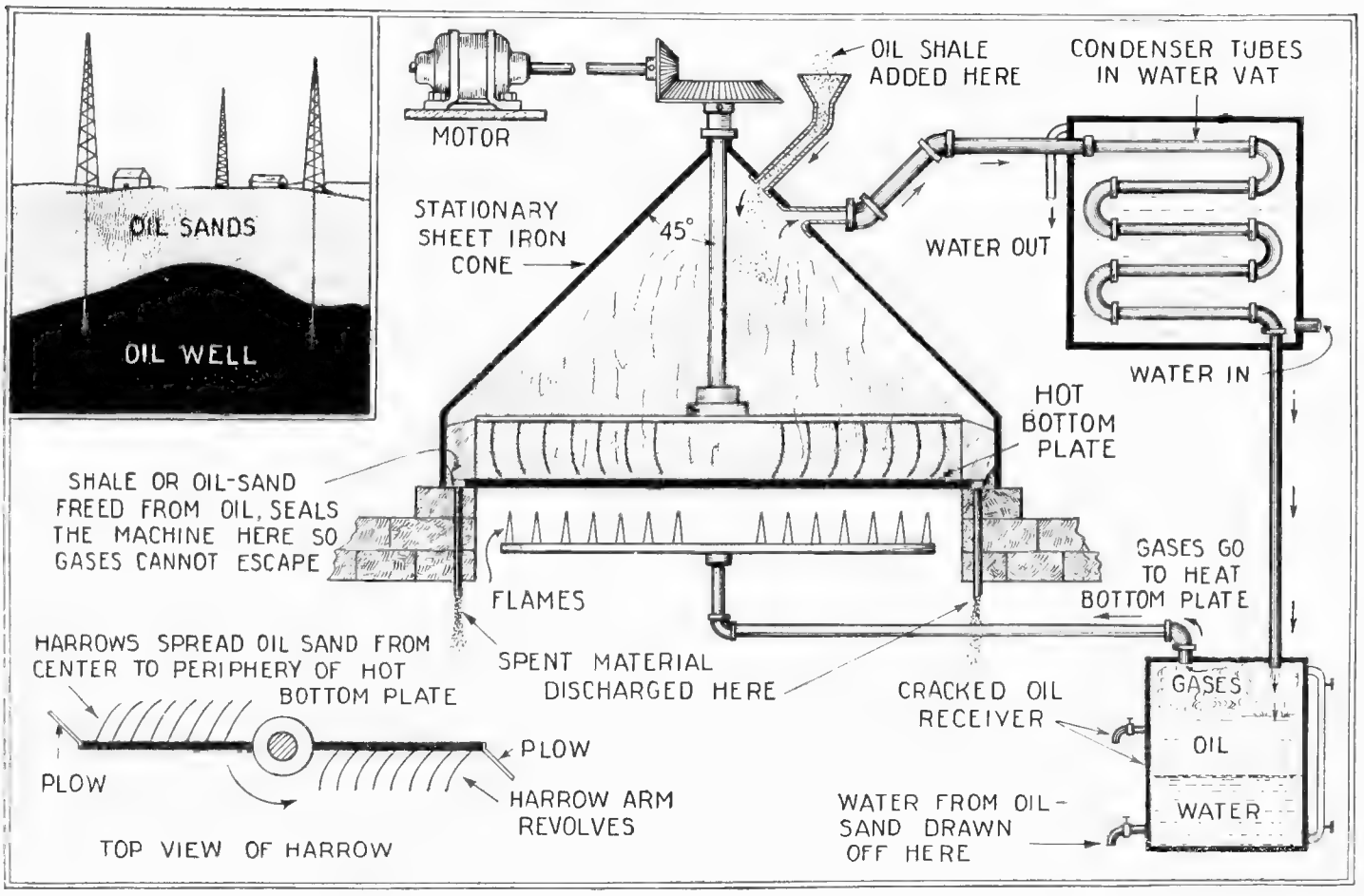
A New Source of Oil

By RAYMOND B. WAILES



The apparatus for distilling the oil from shale and very heavy oils. The oil begins to distill off as soon as it strikes the hot plate.

Difficulties with other processes using the same raw material have been removed in the Bowie-Gavin method of shale oil recovery.

OUR Government geologists estimated several years ago that our total oil resources amounted to about 8 billion barrels of oil. We are using 750 million barrels of oil annually. Consumption of oil is increasing every day. Oil wells are continually going dry. New wells are being brought in. When an oil field is abandoned as dry, only about 20 percent of the oil has been pumped from it. The remaining 80 percent of oil which cannot be brought to the surface with pumps or natural flow simply remains soaked up in the sands. We have all heard of oil shales. The oil shales of our Western Central States contain more than 100 billion barrels of oil. But when our oil wells dry up, and this time will come sooner or later, as the above facts show, how will the oil be extracted from these shales and oil soaked sands?

Two engineers of the Bureau of Mines, C. Bowie and M. Gavin, with a keen foresight to the future, have developed a process by which these sands and shales and also very heavy oils, which are not worked at present, can be extracted and converted into the many products which oil now furnishes us.

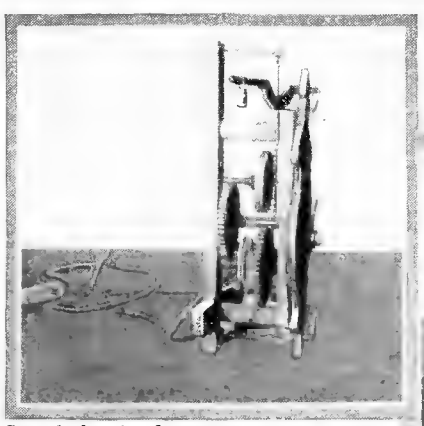
Our sketches show the semi-commercial apparatus for distilling the oil from the shales and also from very heavy oils. The oil from this process is a cracked oil and about 20 percent of gasoline can be obtained from it.

Difficulties with other processes using the same raw material have been the plugging up of the oil vapor escape pipe by carbon which is formed when the oil is vaporized and cracked. This carbon is in the form of a hard, dense lampblack. This free carbon would also adhere to the sides of the wall of the retort and prevent the heat which is applied to the outside, from coming through and heating the oil shale and sand within.

In the Bowie-Gavin process, the oil shale or sand is dropped into the conical housing by means of a screw-operated hopper. The material falls upon the hearth plate which is heated underneath. If a heavy oil is to be treated or cracked to produce gasoline, lubricating oil and the other petroleum products, it is mixed with some inert substance like oil shale or oil soaked sand. Some of these thick oils in cool weather can be shovelled like mortar or putty, they are so viscous. These oils are not now worked, owing to the difficulty in handling them.

As soon as the oily material strikes the hot bottom or hearth plate, after leaving the hopper, the oil begins to distill off. Rotating rabbles, somewhat like the harrow used on the farm, pass over the mixture and spread it towards the circumference of the shell. The spent shale or inert material then drops through the space around the false bottoms out of the apparatus. Some of the material banks up along the inside and thus acts as a seal to keep the gases and vapors in. The oil vapors pass out through an exit pipe and are led to a condenser, where the oil condenses as a liquid. From it gasoline can be distilled. Gas is formed which passes out oil vapor outlet pipe to burners.

Unusual Clock



Carved by hand out of wood, this strange clock of ancient origin is still keeping excellent time for its owner. The "works" are composed of four wooden wheels and the pendulum is situated at the top of the time piece.

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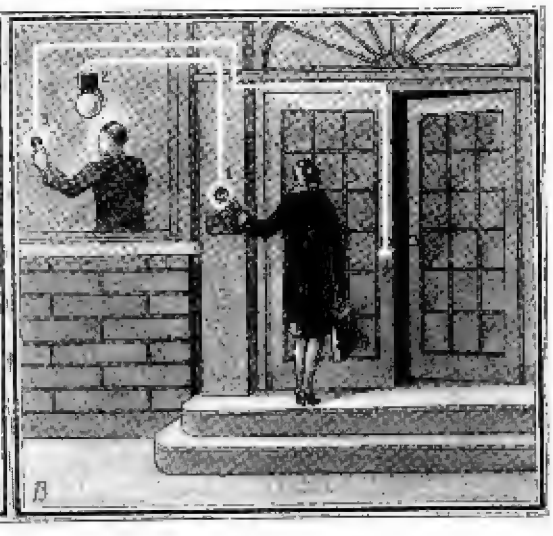
What Is Relation of Sight and Speech?

THE WONDERS OF

A simple reflex. Striking the knee with the hammer at 1, sends the stimulus to 2, in the spinal cord, which acts on nerve cell at 3, and causes muscle, 4, to bring foot into dotted position.



The electrical analogy for the action depicted in the diagram at the left is indicated in B above. The push button, 1, sends the stimulus to 2, which corresponds with the spinal nerve cell. This causes button, 3, to be pressed and produces action at 4.

IF one steps from the investigation of the single elements to the contemplation of the complete nervous system, we come upon astonishing resemblances between arrangements of Nature and the electrical lay-outs of human technology. The human nervous system resembles the telephone network of a city. Like this system the nervous organs comprise a number of independent single apparatus, which by contact, are bonded to the general system, but in other ways have their own individual peculiarities. These independent parts are the nerve cells. Every nerve cell forms, with all of its connections, a biologic and functioning unity, which one designates as the nerve-unity, the neuron. The human system is a complex of neurons. The neurons do not grow together, but are in contact by means of the nerve system with the neighboring neurons. Many investigators believe that these contacts are analogous to the plug-contacts used in our telephones, as the end fibres of the nerves by stretching out make contact and then by drawing back, "when through speaking," again break off the contact. On account of the obvious difficulty of microscopically observing the living nervous system during its activity, it is difficult to demonstrate or refute its other functions just as in the case of other nerve hypotheses.

THE SIMPLE REFLEX ACTION

As the single connections in our telephone systems, so in our nervous systems, the individual neurons only in a few cases cover the entire system of "receivers," but usually only start as the result of the reception of a "transmitter" by the "central station," which is the spinal marrow of the brain and here gives its excitation to the connecting neurons. In contrast to the single neurons, the entire stretch which excitations pass through is designated as the transmission system, and in individual cases it may be designated as the transmission line for sensations as of pain, hearing, feeling, or when motion is involved, as the motor line. The simplest line of excitation between two neurons is the reflex line. If one crosses one leg over the other and allows the upper leg to hang down freely, and if one strikes with a hand or a little hammer right under the patella, against the stretched tendons of the knee muscles, the excitation will be carried from one sensation neuron back to the spinal marrow (1-2), and then through a multiple contact to a motor neuron (3-4), which carries the excitation from the spinal marrow to the substance of the excited muscle, and excites the muscle filaments to contraction.

As an answer to the excitation of the blow against the tendons, the muscles contract. The excitation travels from the epidermis to the spinal marrow, and hence, just like light from a looking glass, is reflected back and travels to the periphery. We call this progress of excitation a reflex and the reflex just described is a knee-tendon reflex. The nerve conductor system of the knee-tendon reflex represents in layout and transmission a single electric call and answer apparatus, such as we use, for example, in an automatic door opener (B). Outside the door, there is a push button (1). If we press the button we carry excitation to a bell (2). Here the excitation operates an automatic contact, or else a porter with a second line (motor neuron) going to the periphery (3), which by the current transmitted, opens the house door (4).

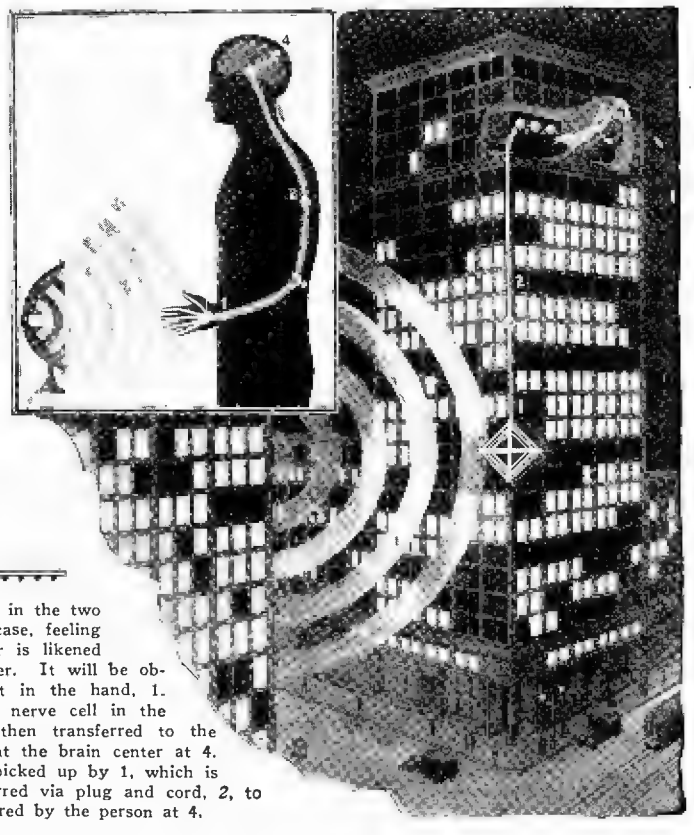
The system becomes more complicated when it is not limited to the line of skin-spinal marrow-muscle, or doorbell-porter-hall door, but goes on into the region of consciousness or into the room of the tenant.

THE PERCEPTION OF HEAT

We warm our hands a little at an electric heater; just what happens? Ether waves which we feel as heat stream out against our skin. Here they are received by the spreading filaments of the terminal sensitive nerves, just as radio waves are picked up by an antenna, just as the hammer blow on the knee tendon was carried by a sensory neuron from the periphery to the spinal marrow (1). Here the nerve excitation is communicated to a second neuron, whose function it is to carry the nerve current through the spinal marrow, up into the brain in contrast with the reflex action (carrying it back to the skin). Here the second neuron ends in the base of the brain. This central base of the human brain corresponds to the foundation of the brain acquired by the vertebrate animals and contains as the oldest portion of the brain, the primary center of perception, by which the lower members of the vertebrate feel the excitation of the outer world and register it.

Here the excitations are "qualified," that is to say, are registered individually as light, heat, feeling or hearing, but are not yet comprehended. The reception power of this central stem is of lower grade than the intelligence area, just as for us men, the presence of the ground during an exciting entertainment is not perceived. We feel at every step whether the surface is hard or soft, we automatically adapt our muscle tension thereto, and if we find ourselves first going over a soft foot path, and suddenly are on a paved street, we at once react to a perfect switching in "of the walking mechanism"—but the sensation does not come to our consciousness. So we are, for example, entirely filled with the discourse on the tragic fall of the kingdom of the Incas and our conscious thoughts and feelings are far back in the sixteenth century among the inhabitants of old-time tropical America.

For the dawning intelligence of animals, to rise to the clear human intelligence, this function must go from the lower part of the base of the brain into the cortex (3). Here the excitation is passed on to a fourth neuron, the superficial brain cell which represents the organ of intelligent perception (4).



Another analogy is indicated in the two illustrations here. In this case, feeling heat from an electric heater is likened to radio waves and a listener. It will be observed that the heat is felt in the hand, 1. The stimulus passes to the nerve cell in the spinal cord at 2, and is then transferred to the brain at 3, and registered at the brain center at 4. In B the radio waves are picked up by 1, which is similar to the hand, transferred via plug and cord, 2, to the set, 3, and registered by the person at 4.

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OUR NERVOUS SYSTEM

Nervous System Like Telephone

In this diagram an analogy of how the brain works from the time the eye sees an object until the object is named, is given. Further explanation is found in the accompanying text.

If the reception of ether waves through the human nerve system is compared with the same reception by a radio set, we come across a striking analogy in construction. The first neuron, the sensitive neuron, which receives the ether waves of the outer world by its spreading filaments and carries it into the interior of the body is the antenna that receives the ether waves and takes it inside the house through its conductor (1). The second conducting neuron represents the connections which within the residence run from the end of the antenna to the radio set (2). The third neuron, the basic brain neuron, is a radio apparatus (3). Here the ether waves are distinguished, and changed back, as it were, into the quality of the excitation received and given back as the human voice, the tones of an organ, or the sound of a violin; but the radio apparatus itself feels nothing, only man listens to it. In man the operation of the radio apparatus converts knowledge into experience, we have the fourth neuron, the peripheral brain cell, the organ of intelligent perception (4).

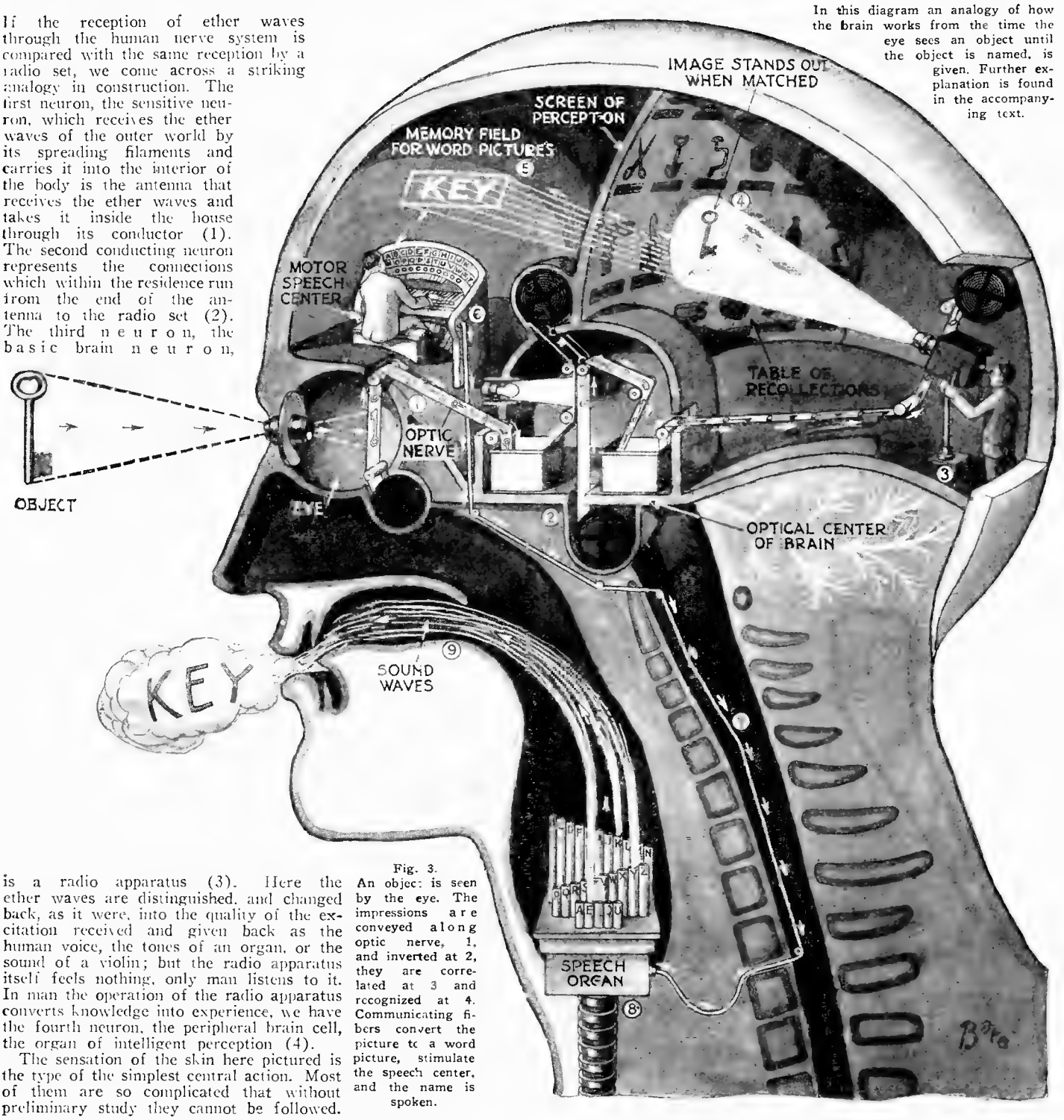

Fig. 3. An object is seen by the eye. The impressions are conveyed along optic nerve, 1, and inverted at 2, they are correlated at 3 and recognized at 4. Communicating fibers convert the picture to a word picture, stimulate the speech center, and the name is spoken.

The sensation of the skin here pictured is the type of the simplest central action. Most of them are so complicated that without preliminary study they cannot be followed.

HOW "WORD PICTURES" ARE FORMED

One contact system which is still easy to understand, but involves over eight different neurons, is one of our intellectual actions which is most frequently used, where we give a name to an object which we see. In Fig. 3, the progress is shown in mechanical reproduction in the picture. We see a key and say: "key!" Now in this sixth of a second what has happened? First the image of the key reduced by the lens of our eye is thrown upon the camera obscura of our eyeball and here is thrown upon the light sensitive lining of the retina. Under the influence of light the retina is changed and apparently sets free various chemical combinations which act as excitants of the nerve cells here present. This excitation in some way unknown to us is changed, and is communicated to the first transmission neuron, a nerve cell whose sheath of nerves goes from the retina into the optical center at the base of the brain, which along with its nerve threads from other cells, forms a thick cable with some million of individual threads, the optic nerve (1). The image is transferred from the retina to the optical portion of the brain "telegraphically" through a cable.

It will be seen that in Fig. 3 the human reception of an image is maintained and the optic nerve is shown as a picture film, which in the back of the eye-ball is illuminated and then goes on to the optical center of the brain. In this center (2) the picture is developed and qualified; here it appears as a picture of a key. The picture now seen exactly as in the case of a skin sensation, is passed over to a neuron that carries it from the depths of perception and out to the cortex of the brain in the region of clear perception. Speaking as if it were a matter of photography, the negative is changed into a positive, is copied, and sent through the path of vision to the promulgation apparatus. Here the peripheral cells of the human brain (3) receive the picture as something experienced. The picture is thrown on the screen of perception (4) and there it appears as the picture of the key, which is in the outer world in front of us. The screen of perception is at the same time the table of recollections. It is not white and empty, but dark and carries the intaglios of all those pictures that have been impressed upon it in the past. The image of the key travels about over the surface; it seeks here and

(*Continued on page* 162)

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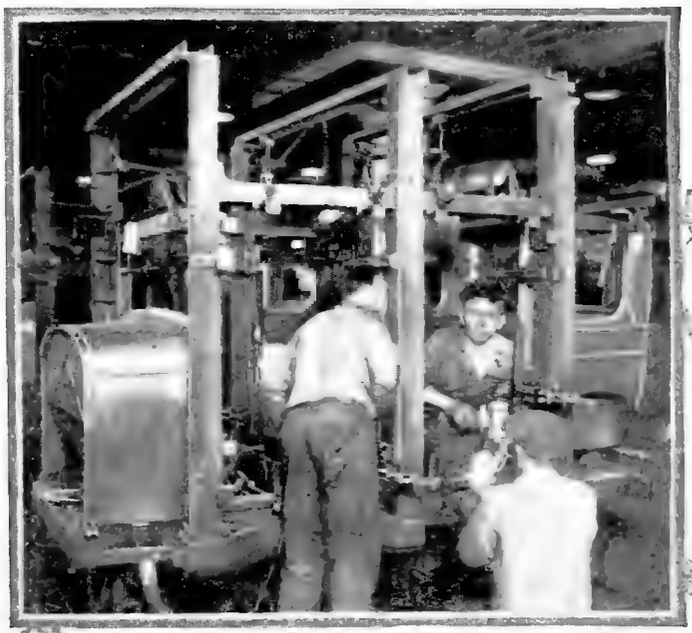
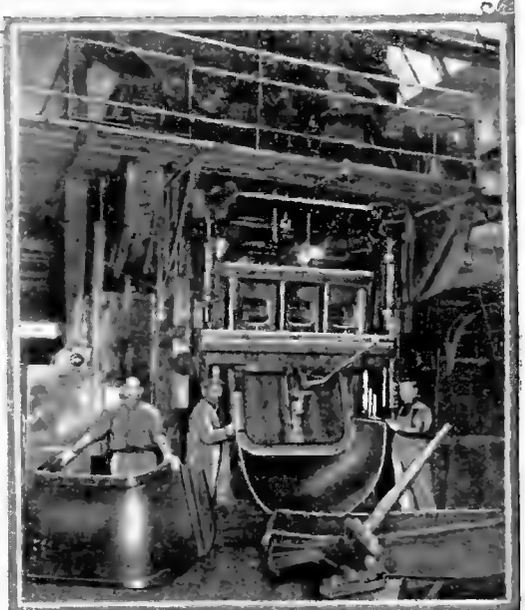


Above and to the left we see respectively the welded steel auto body and the electric welding frame in which the sections of the metal body are spot-welded together. As you look at the beautiful cars rolling down the avenue, you little dream that, thanks to the magic of modern die-punching and spot-welding, a complete steel auto body can be turned out in forty-five minutes from the time the sheet steel entered the factory. One of the huge punch presses appears in the photo below.

Making Steel Auto Bodies

By H. W. TOWNSEND

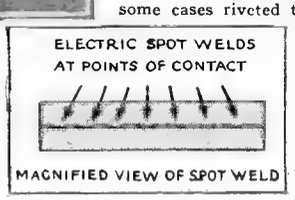
THE accompanying photographs and drawings show how some of the operations are carried out in producing the modern steel automobile body. As you may or may not be aware, up until recently motor car bodies were practically all built up of wood covered with thin sheet steel or sheet aluminum. This system of building up the motor car bodies followed naturally from the system of building carriage bodies. In other words, the old time carriage builders gradually became auto body makers. But this combination of wood and metal body had many objectionable features, among others being the relatively high cost of production and particularly the fact that the bodies could not be made exactly similar. This being the case, doors all had to be fitted individually as well as other parts of the body, such as windows.

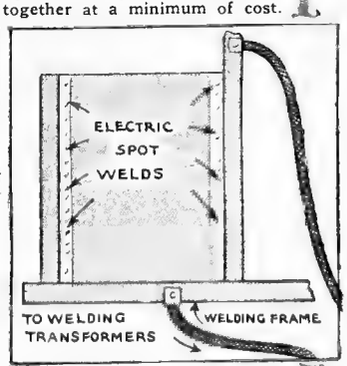


By means of electric spot-welding, which causes two pieces of metal to be firmly joined together wherever they are in contact, when the electric current passes from one piece of metal to the other as the diagram below shows, steel auto bodies have their sections all joined together in one flash of current. Small parts are spot-welded and in some cases riveted together at a minimum of cost.

Photo above shows doors being hung in place on metal auto bodies as they move along on a continuous platform. Picture at right shows finished metal bodies moving along on rails and they are painted by spray process while they are in motion.

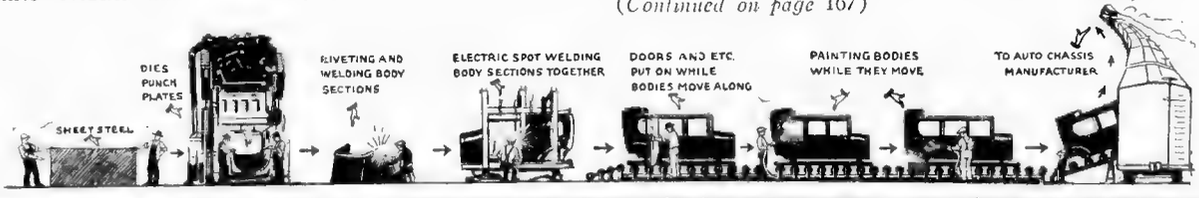
One of the heavy steel dies used for punching out door frames is shown at the left. They are used in powerful presses.





With the modern all metal body, the door and window openings can be made accurately to size, so that all are identical. It at once becomes evident that the doors, for instance, can all be made to a standard size, so that they can be fitted on by simply hanging them on their hinges. As a matter of fact, this is just what happens, the door fitters hanging the doors, while the bodies travel by them slowly on a moving belt, as one of the accompanying pictures shows. Not only are many other operations carried out on these all metal bodies while they move by the mechanics on a continuous platform or belt, but they are painted in the same way, while in motion. At present, of

(*Continued on page* 167)


DIES PUNCH PLATES
SHEET STEEL
RIVETING AND WELDING BODY SECTIONS
ELECTRIC SPOT WELDING BODY SECTIONS TOGETHER
DOORS AND ETC. PUT ON WHILE BODIES MOVE ALONG
PAINTING BODIES WHILE THEY MOVE
TO AUTO CHASSIS MANUFACTURER

The successive stages through which your steel auto body passes are shown in the movie strip above. The process occupies 45 minutes.

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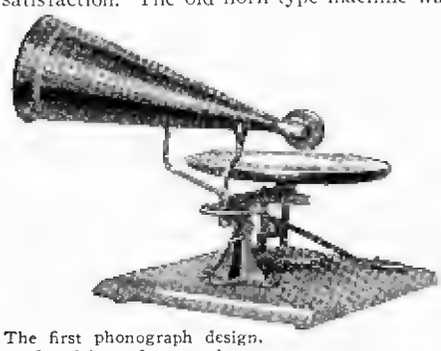
How a Famous Phonograph Was Invented

The Human Interest Story of a Machinist With An Idea

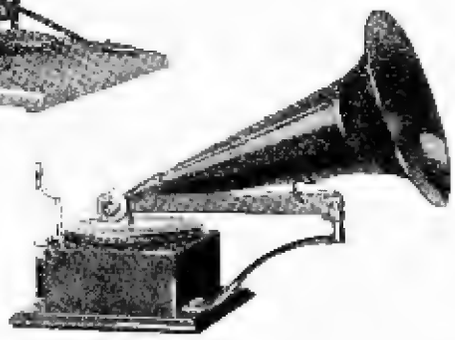
By W. H. JENKINS

(CONCLUSION)

ONE idea that was firmly implanted throughout his organization by Mr. Johnson was that nothing was ever quite good enough for complete satisfaction. The old horn-type machine was good, but not good enough. The cabinet machine was the next step, and finally, in 1925, in the midst of a period when radio was occupying the center of the stage, the new Orthophonic and the Electrola models were introduced.



The first phonograph design, produced by a famous phonograph company is shown above. Note that it is hand-driven. We wonder how many of these machines would be sold today? The first type of spring-driven phonograph manufactured by the same concern is shown on the right. This type of phonograph was standard for several years.



From time to time, as the business developed, the research laboratories were enlarged. It was realized, however, that there were other great scientific and industrial organizations that were spending far more money in acoustical research than Mr. Johnson and his associates could afford to invest in such work.

Therefore, when it was learned that the Bell Telephone Laboratories of the Western Electric Company and the American Telephone and Telegraph Company had developed both a new method of recording and a new talking machine which far exceeded in range and quality the old recording and reproducing methods, the method was eagerly investigated. Independent research in the Camden, N. J., laboratories had proceeded sufficiently far toward improved reproducing methods to enable officials of the company to appreciate the full significance of what had been developed in the Bell laboratories.

Right to use the new electrical recording process of the Western Electric Company, and the exclusive right to manufacture and sell the new reproducing instrument, which is now known as the Orthophonic, were immediately acquired. Incidentally, this action resulted in making commercially available, through co-operation of two great industries, the by-products of telephone research.

Therein lies another *romance of science*, which has already been related in previous issues of SCIENCE AND INVENTION. The principle of matched impedance, which governs the design of the orthophonic talking machine, is a mechanical application of the electrical principle which made possible long distance telephone communication.

The new electrical records and the orthophonic reproducing instrument were made commercially available as soon as old stocks could be disposed of, and the factory converted to production of the new developments. Introduction of these new products came at a time when radio was holding the limelight. Improvements of the talking machine and recording had lagged. The orthophonic principle was therefore a tremendous musical, industrial and scientific surprise.

In November, 1925, the new instruments were demonstrated simultaneously throughout the United States. In a single day two million people heard them. In two weeks orders had been placed for a total of $20,000,000 worth of orthophonic instruments, at factory prices. An industry had been completely revolutionized, almost overnight.

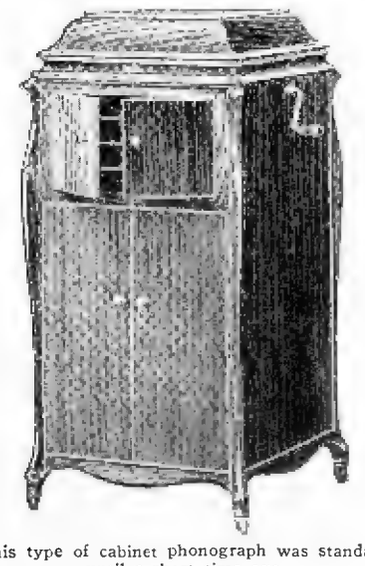
Following introduction of the orthophonic instrument, the company placed on the market combination instruments containing both orthophonic reproduction from records and radio receiving sets. Next came an electrical amplifying talking machine, developed by the General Electric Company's experts and having extraordinary volume capacity. This electrical instrument is marketed as the Electrola. In some of the large models radio receiving equipment, orthophonic reproduction from records and electrical reproduction from records are combined in a single cabinet, thus affording the latest acoustical developments for providing music in the home.

The recent sale by Mr. Johnson of his majority holdings in his company to a group of bankers has concentrated public attention upon the magnitude of the business built up by this inventor and business man in twenty-five years. Today the company has a capitalization of $49,070,000. It has branches or affiliations at strategic points throughout the world. It produces records in about thirty-five languages and dialects.

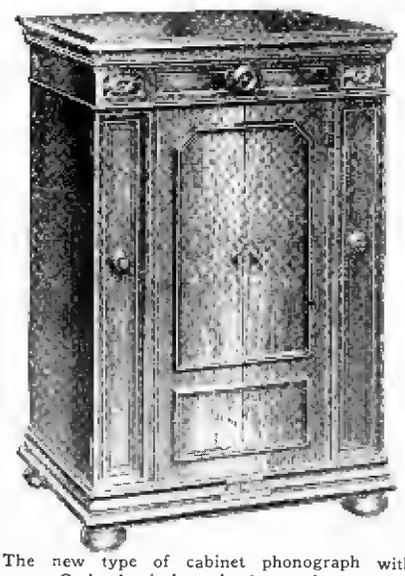
(*Continued on page* 166)

The new method of electrical recording for phonograph records is shown at the right. Compare this illustration with the one below and note how much less crowding the new method produces. Note the broadcasting microphone.

The illustration on the left shows the method used for recording for about 20 years. Note the instruments pointed towards the recorder.



This type of cabinet phonograph was standard until a short time ago.



The new type of cabinet phonograph with Orthophonic horn is shown above.

The newest Orthophonic phonograph appears above. It plays twelve records automatically and then stops. The arm seen on the left holds the records and replaces them. The finished record is placed in a compartment. The needle and tone arm are moved automatically after each record is finished.

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Freak Plants and How They Are Produced

By DR. ERNEST BADE

A spindle tree made into a tiny dwarfed growth, deformed by the Japanese and kept in its tiny state throughout its life.

A columnar cactus upon which a hedge-hog cactus has been grafted and deformed by a lateral cut.

The Thuja is a conifer and as such is usually a comparatively large tree but kept the Japanese way it is a tiny midget.

CULTURE—What a wealth of meaning lies hidden in this word. Household animals, stock raising, farming, gardening, etc., all are included. For man, from a utilitarian standpoint, is closely united with both the plant and the animal kingdom. He protects them, uses them, and favors them with his attention but those plants or animals that are obnoxious to him he discards and destroys or at least he attempts to limit their propagation. As every external influence of environment so is that of man seen upon those forms he has favored. Some he has allowed a certain degree of world conquest, but his influence remained, and a gradual change was effected. The fruit tree is protected and the thorn is destroyed. But man tries to improve what nature has so bountifully provided, and why should one not try to make the thorn produce a pleasing sweet and tasty fruit. But no names have been handed down to our times of those men who made the first experiments with plants. Under their skillful care, many experiments were brought to a successful conclusion and this developed a newly created world, a kingdom of plants and animals changed by man for the benefit of mankind the world over.

A crawling or climbing cactus grafted on a columnar cactus makes a unique whole and causes the flowers to be more prominent.

This is the wild form of the Chrysanthemum from which originated through crossing, some of our gigantic filled forms of this flower.

Such changes were only made possible by the naturally variable character of these organisms. They were not constant, they had no definite, unchangeable form, and they had no definite unchangeable peculiarities. Everything blends in nature, one form gradually goes over into another, no organism resembles another in identity. The lesson of development, known in prehistoric times, is by no means a lost art. It still exerts its influence, and will continue to exert it as long as life remains upon the earth. All living things can be trained, the existing propensities of life can be developed, and inherent properties can be brought out. These are the facts which the stock raiser and the agriculturist must take, and does take, into consideration in the development of those forms of value to man.

Ancient volumes treating of gardening, mention rose bushes upon which apples grow, strawberry trees, and other curiosities. An explanation of these abnormalities probably lies in the fact that the people of that time did not call the fruit by the name by which we recognize it, but meant an entirely different one. In some cases this is undoubtedly true. Today, such things are seen from a different point of view, for in those times, it was a rule that only similar, or closely related plants could be crossed or grafted. Shoots of fruit trees can now be grafted on deciduous trees, and herbs can be crossed with berry bushes or tree. A tree, producing apples on certain of its branches and pears on others is by no means a rarity. Then, too, bushes, developing both currents and gooseberries can sometimes be found in gardens, where the experienced gardener, through budding or grafting has had a lucky hand in his work.

In the gardens of Prince Putbus on the isle of Rügen, stands a tree whose twigs are alternately covered with beech and oak leaves. Here one part of the tree does not produce oak leaves, and the other beach leaves, but, on the same twig there are alternately oak and beach leaves. About 40 years ago in Marienburg a buckthorn grew that had early yellow plums on some of its twigs. A climbing rose with pale rose colored flowers has also been mentioned which produced dark red cherries on some of its twigs. Whose hand grafted these unrelated species, is not known, but that it was purposely done cannot be doubted, and moody nature let the grafted shoots grow, flower, and thrive.

At the Gardeners' Congress in Paris about 20 years ago a Frenchman, grafted roses upon willow. He also showed cherries and cucumbers which grew upon a high stemmed currant. In all probability the cucumber seeds were here carefully set in the bark of this tree-like shrub. By exceptional care and cultivation, the seed was brought to germination and development.

Many new varieties of fruit are only found through chance, or are a result of

(*Continued on page* 169)

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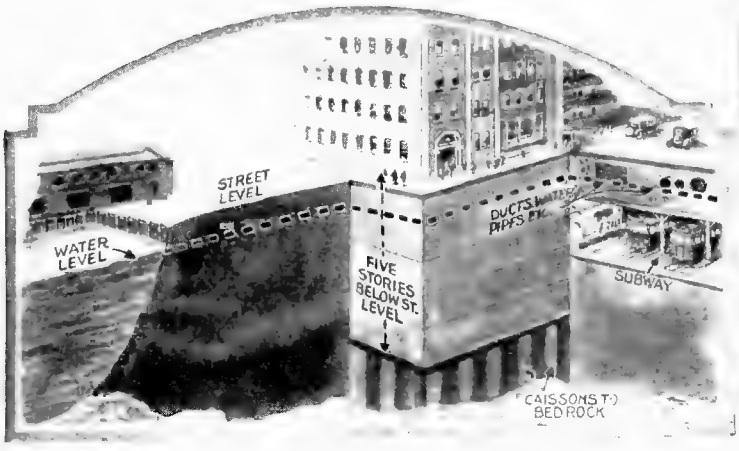
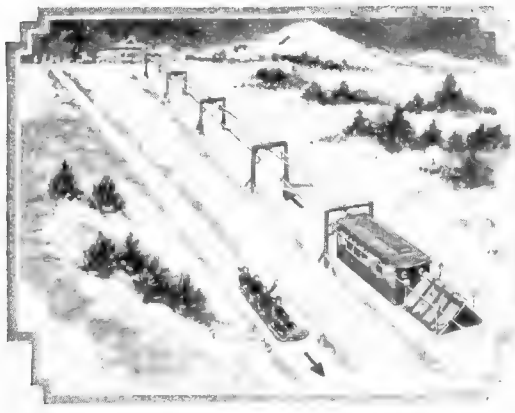
The Month's Scientific News Illustrated

By GEORGE WALL



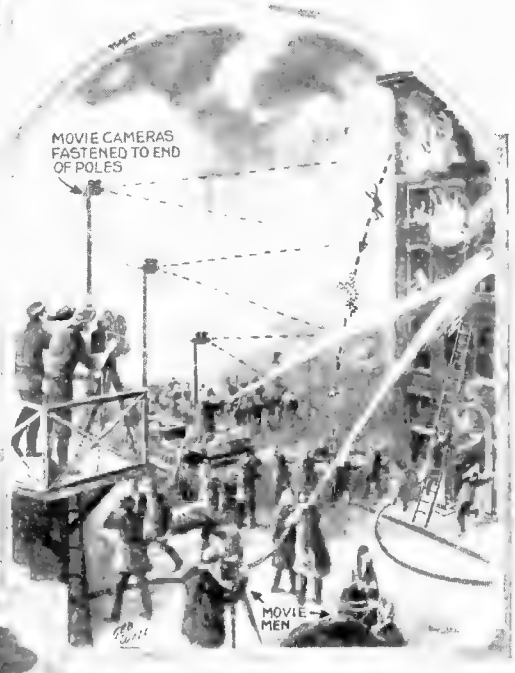
New York is fast becoming a city of underground spaces. The street surface of New York is only 45 feet above the ocean level, while the subway's and sky-scraper's roots reach far below the surface. The bulk of the tall buildings have their foundations below the water line as revealed by a survey made by the Associated Press. New York's rise into the air has taken second place in constructional activities this season, in comparison with the city's rapid descent into the earth.

Two American observers recently left the United States to conduct solar observations from the top of a South African desert mountain. A cave has been fitted out with all the comforts of home and the observatory instruments installed. The Mount Brukkaros observatory is the third one to be established in connection with the study of solar radiation which the Smithsonian Institute has been carrying out for more than 30 years.



At a famous German winter resort one can shoot down a mountain two thousand feet high all day long without walking more than a few steps. A toboggan slide three miles long has been laid out from the top of Mount Kreuzeck. This slide ends a few yards from the start of a suspension cable car which pulls the coasters back to the top.

There will be no more cold feet for Berlin trafficmen policemen in winter if a system of artificial hot-water bags at street intersections finds general adoption. Electric heating devices have been installed in the heavy glass case safety islands upon which the policemen stand.



More than fifty cameras, a large number of them electrically controlled, were used to photograph the difficult fire scenes in the "Fire Brigade," Metro-Goldwyn-Mayer's new photoplay. Every flicker of action was covered when the battery of camera men started to grind away on the spectacular sequences. Specially designed machines, controlled by electricity, were fastened to the ends of poles, and thereby caught many scenic angles which were impossible to "shoot" in any ordinary way.

Ernest Vollbehr, a Munich painter, is the first artist to paint landscapes from an airplane. He is exhibiting a series of fourteen landscapes which he sketched during repeated flights between Munich and Geneva. His canvases show the beauties of the Alps and the Bavarian highlands. Vollbehr, a veteran of the war, is one of Germany's leading artists and has achieved fame with his paintings of the African jungle. This is the first time that an artist has worked in mid-air. Vollbehr's paintings are really aerial sketches of the panorama which swings beneath him during his flights.

In New Zealand coal is carried more than five miles from a mine on a mountain by mixing it with a stream of water which is forced through a large pipe. The pipe line runs to a lake where the water enters. This line joins the main pipe line into which the coal is dumped. As shown in the drawing, the pipes are laid in Y-shaped formation. This ingenious device has been in successful operation for some time and has been found to be cheaper and more efficient than the common way used to transport coal. Another feature of this arrangement is that the coal is washed and entirely freed from dust and other impurities. At the receiving end the coal is caught in a huge screen which allows the water to drain off and yet retains the coal.

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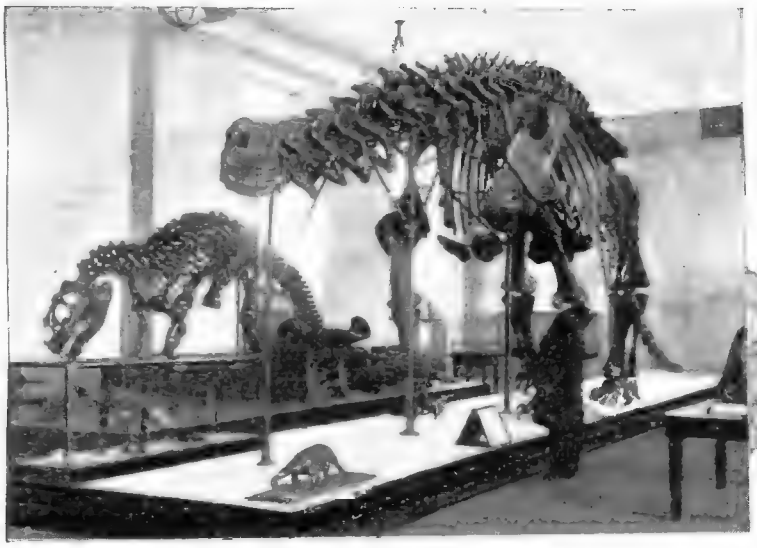
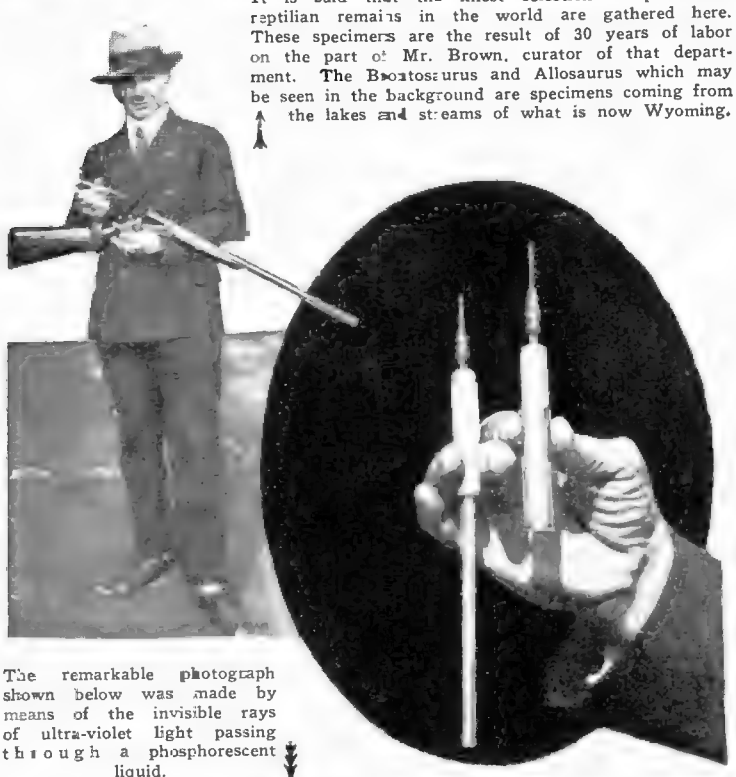
Science Snap Shots



A view of the new Dinosaur Hall which was recently opened at the Museum of Natural History in New York City. Animals that roamed the earth 30,000,000 years ago may be seen.

It is said that the finest selection of prehistoric reptilian remains in the world are gathered here. These specimens are the result of 30 years of labor on the part of Mr. Brown, curator of that department. The Brontosaurus and Allosaurus which may be seen in the background are specimens coming from the lakes and streams of what is now Wyoming.

A new tennis innovation borrowed from archery has been introduced on the Huntington courts at Pasadena, California. A large target is used which is placed on the opposite side of the net from the player. The bull's-eye is a hole in the center of the target, the player trying to drive the ball through the hole.



The remarkable photograph shown below was made by means of the invisible rays of ultra-violet light passing through a phosphorescent liquid.

A new use for Ford cars. The car shown above has been equipped with a cab body and flanged wheels so that it may be run along the railroad tracks. The tracks provide a smooth roadway for the car which moves along under its own power.

The "mercy bullets" shown above will be the ammunition of Captain B. W. Harris on his next expedition. The bullet contains a hypodermic syringe, which is filled with an anaesthetic. When the bullet strikes the animal, the needle penetrates the flesh, releasing the drug and rendering the animal unconscious within a short time or it may be released and the animal revived within an hour or two.

The recent invention of Dr. Dowsing of London, is an "electric light bed," by which radiant heat and artificial sunlight treatments are given to patients. Great improvements in health have been claimed by those who have undergone such treatment.

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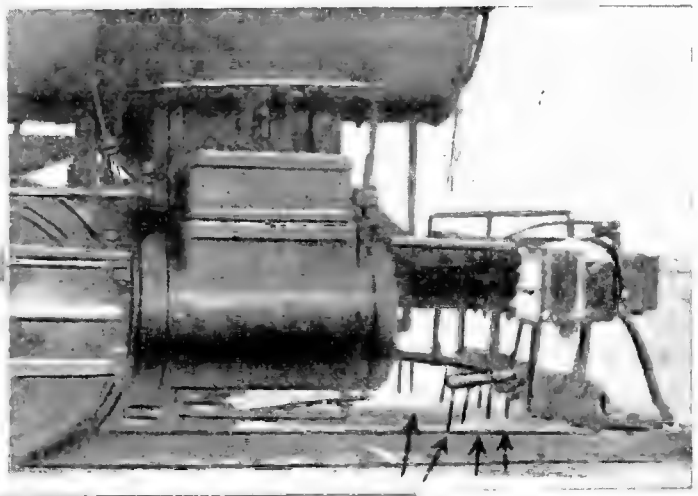
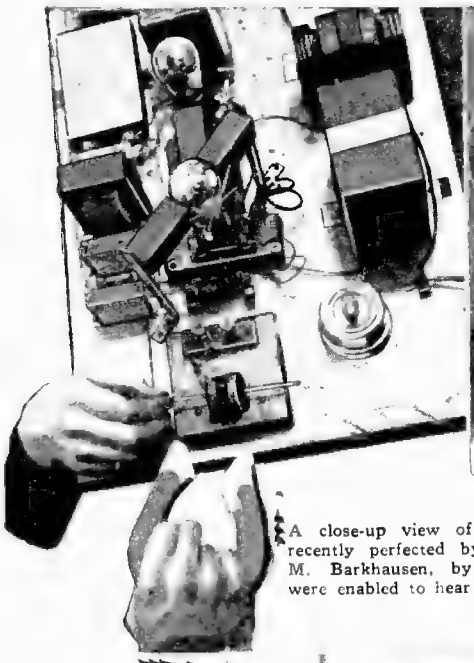
New Inventions in the Camera's Eye

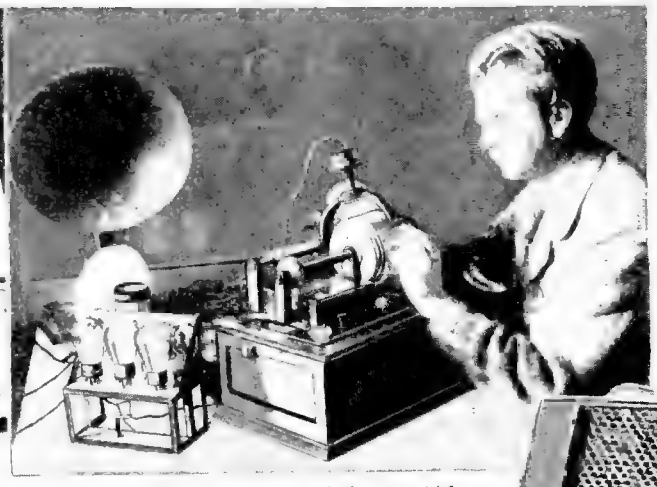
The new steam jet equipped locomotive in action. The cost of installation is relatively small compared to the results obtained with this new apparatus. A locomotive equipped in this manner will remove the snow at a greater rate of speed and with an ease never before obtainable with the old-type snow plow removing devices.

A simple contrivance for clearing snow from the center of the railroad tracks was attached to the locomotives of the Boston and Maine Railroad. A series of jets, attached to the underside of the cow catcher, eject live steam as the locomotive rolls along thereby melting the snow which blocks the tracks. The arrows in the photograph below point to the steam jets situated on the forward part of the engine.

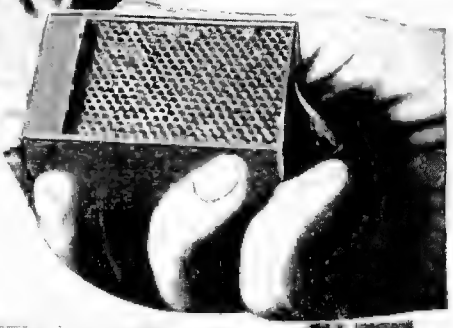




A close-up view of the ingenious device recently perfected by a German scientist, M. Barkhausen, by which the scientists were enabled to hear the roar of the atoms.

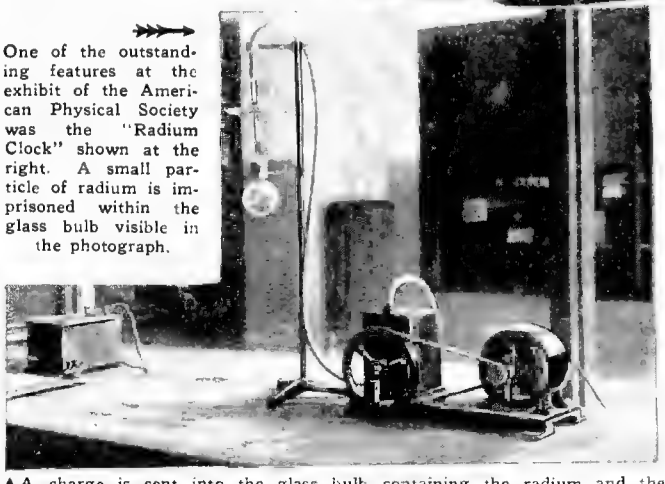


Mr. J. L. Baird of London, England, is shown demonstrating his latest invention, the "Televisor," which is said to successfully record the "sounds made by living scenes." It is claimed that he has already photographed the sound made by faces, hats, scissors, cabbages and other common objects. At a demonstration given to the members of the Royal Institution in England, the apparatus was declared to be a success.



The electrical eye which sees in the dark and is the heart of the new "Televisor" is shown at the right. This small cell makes vision in total darkness possible by recording the invisible rays.

Prof. S. L. Quimby at Columbia University, is shown at the right demonstrating the new atom amplifier. The atom's roar is produced by sending a current of electricity through a bar of soft iron, which is surrounded by a coil of copper wire. This causes the iron particles or collection of atoms to become polarized. The north and south poles of each individual atom become definitely arranged. When the current is reversed the atoms become depolarized and fall back to their original position. The sound of the roaring atoms is amplified 8,000 times, thus making it audible in the loud speaker.



One of the outstanding features at the exhibit of the American Physical Society was the "Radium Clock" shown at the right. A small particle of radium is imprisoned within the glass bulb visible in the photograph.

A charge is sent into the glass bulb containing the radium and the Alpha rays of the radium particle force apart the gold leaves of an electroscope. The leaves are alternately discharged at regular intervals, thereby furnishing the energy operating the clock.

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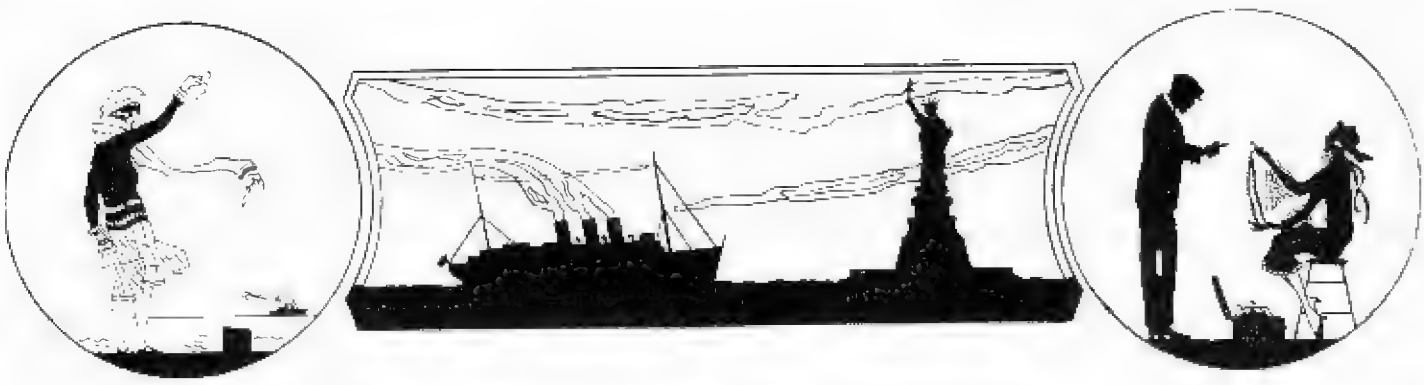
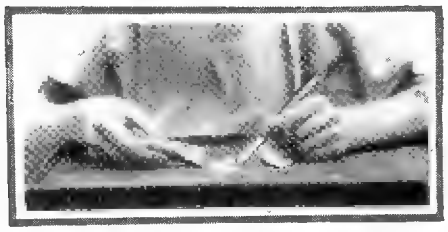


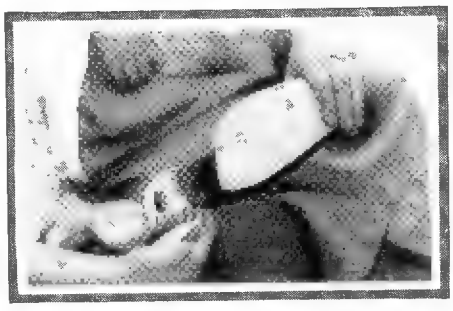
Exposing the Smuggler

By COUNT A. N. MIRZAOFF



A favorite method of concealing contraband jewelry is to imbed the valuable articles in a tube of tooth paste or shaving cream. The Customs officials are always on the lookout for a ruse of this variety, and it is very rarely that the would-be smuggler succeeds with such simple methods.

In the old days, many a cake of soap was brought into the country which was never intended to associate with water. A little careful drilling into the soap affords a very nice cache for the smuggled gems, with a—theoretically—small chance for detection. It is surprising to the average person to learn how easily the inspectors uncover this particular trick, but some few can testify with sorrow.



Some of the smugglers' tricks are comparatively well known, such as the hollow rubber heel illustrated above. Somewhat more ingenious is the false button, which is shown in the photograph just below.

Both of these arrangements provide a convenient hiding place for valuable stones, jewelry and other small objects.

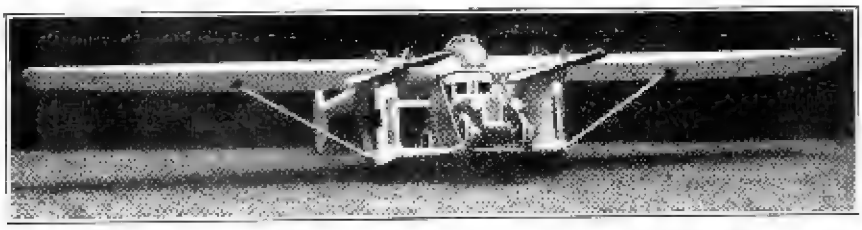
The handles of umbrellas and walking sticks make ideal receptacles for the smuggled material. This is one of the first tricks suspected by the Customs Inspector, and success is exceedingly rare. In fact, few smugglers are successful these days.

The old tricks rarely get by the Custom's officials nowadays and it is only when some new, ingenious method is resorted to that the smuggler is successful.

An ancient and time-honored stunt is the use of a loaded cigar to carry the jewels past the guard. This system sounds all right, but the enterprising smuggler should be careful to remember which cigar is the loaded one, so that if the inspector suddenly asks him for a smoke, he will be properly prepared, and will not make the social error of presenting him with a diamond or two.

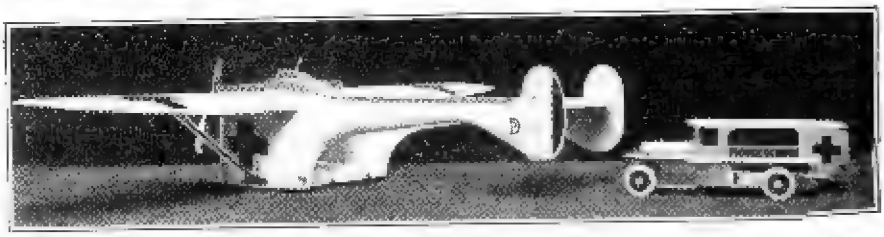
When Your Taxi Borrows Wings

By LUCIEN FOURNIER



The Ne Plus Ultra of comfort can be found in this conception of a French inventor, permitting automobiles to go into the air as flying machines. It surely would be a great convenience if travelers, without leaving their automobiles, could embark in an airplane by driving their car into its fuselage. This particular invention was developed to provide high speed ambulance service, and allowing patients to be transported without shock or discomfort, such as might be experienced if the automobile were driven over bad roads. The machine is fastened into the fuselage of the plane.

This machine is reminiscent of the aero-limousine which was exhibited at the Aviation Show in New York some years ago. This arrangement posesses the added advantage that the automobile may be driven out of the fuselage and used separately from the plane in any way desired. The perfection of this invention should prove of military use.



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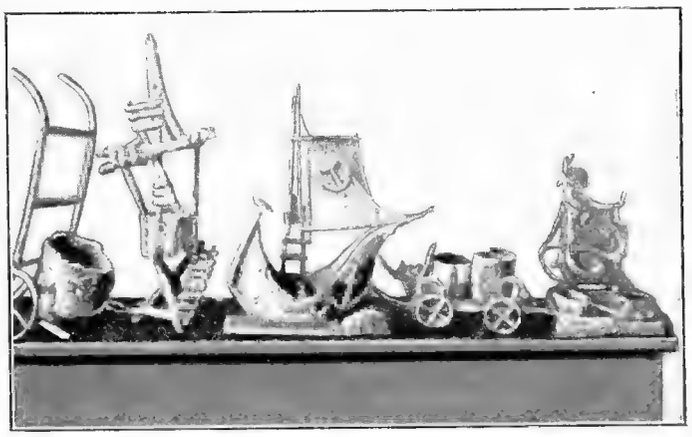
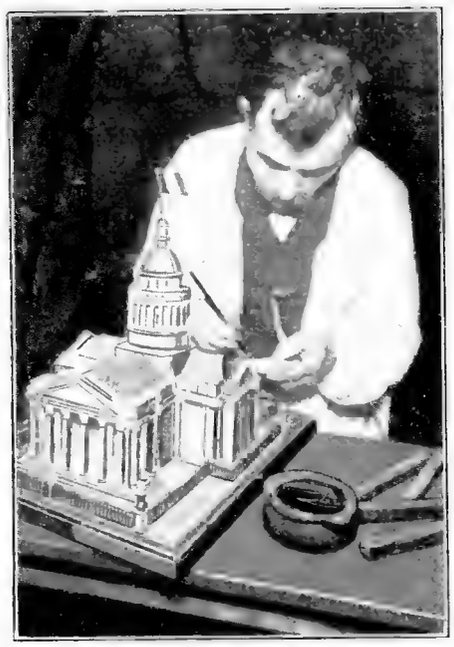
Cork Carving as a Hobby

Very Artistic and Exceptionally Light Articles Carved From Slabs of Cork

The above photograph shows some of the knives used in carving cork. Note the peculiar curve of one of the knives.

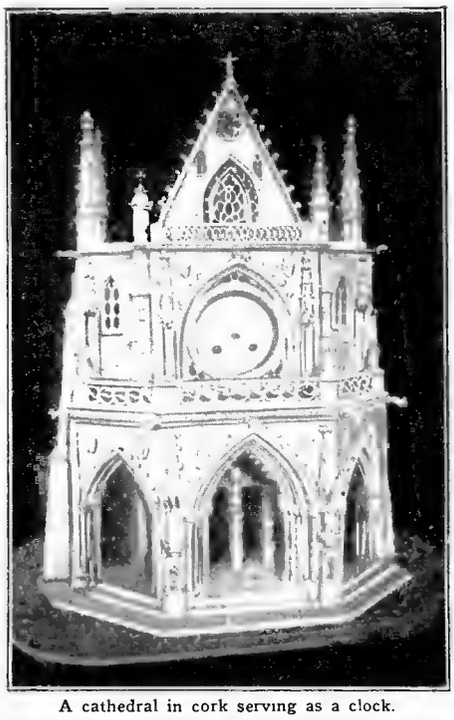


Here are a few receptacles for receiving house plants which are made entirely from cork slabs.



Artist finishing a cork model of the Paris Pantheon.

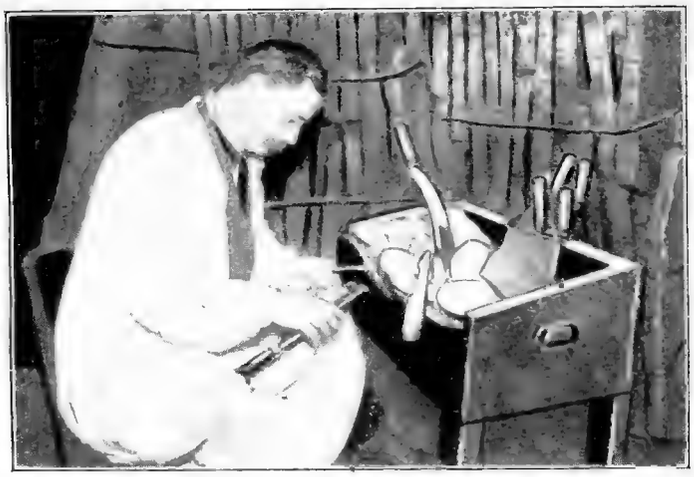
HOBBIES—those elusive nothings which may develop into a new art—not only ease the minds of their possessors, but also while away many dreary hours. On this page we find a series of photographs of a comparatively new hobby, namely that of whittling cork into works of art. The peculiar structure of cork gives the articles a very unique appearance. Being unaffected by moisture, a thin coat of varnish may be applied simply to close the surface pores so that the article may be dusted more easily. Cork requires considerable care in its handling. Unless very sharp tools are used, the cork will break. Any form of a good steel knife, well sharpened, can be used in carving articles made from this material. It will be observed in some of the photographs that large slabs of cork are cut by a scimitar-like knife, the inside edge of the curve being the sharp part of the instrument. Ordinary sandpaper is used for smoothing the article. To enhance the artistic effect certain portions of the model may be painted and some of the new quick-drying paints can well be employed for this purpose because the finish is lustrous and the paint dries very rapidly. With these paints there is little danger that one color will run into another. One coat of paint will give a substantial covering.

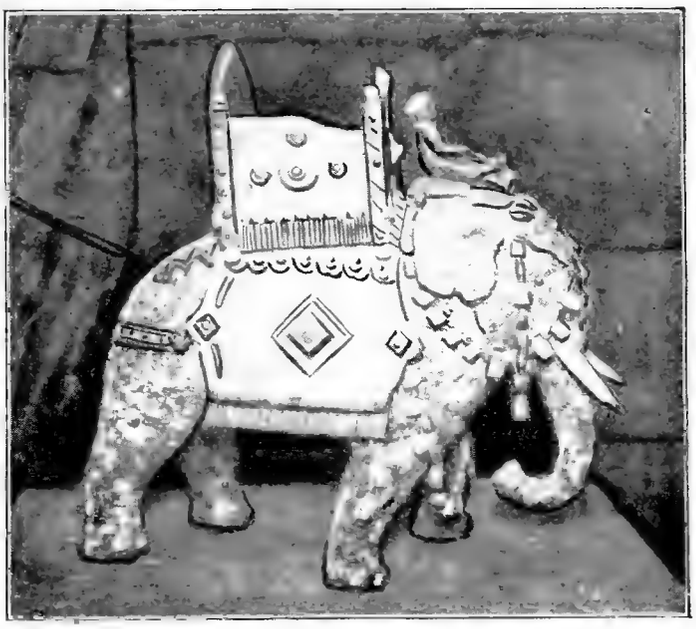


A cathedral in cork serving as a clock.

Here is a model of the famous elephant Rajah cut out of cork. In executing work of this nature it is absolutely essential that very sharp tools be used, otherwise the cork may be broken. →

The photo below indicates how the cork is cut to the desired outline. Various styles of sharp instruments can be employed. ↓





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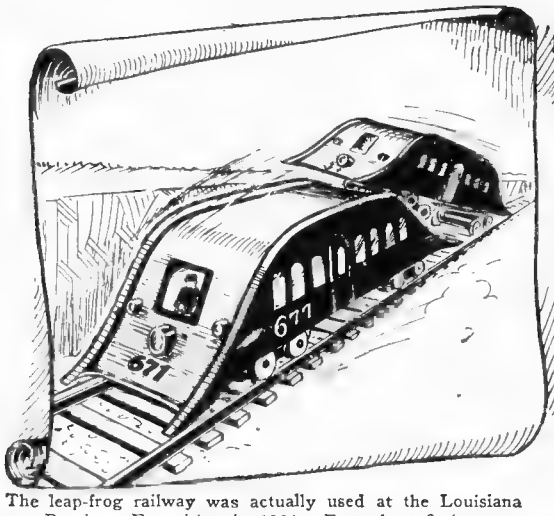
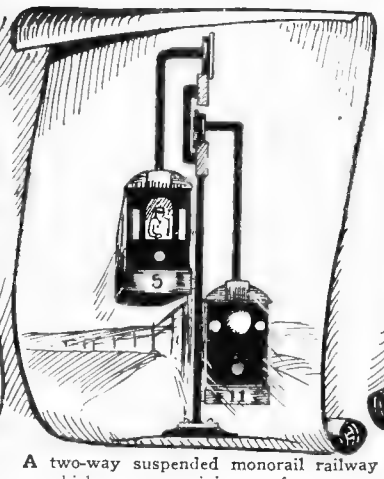
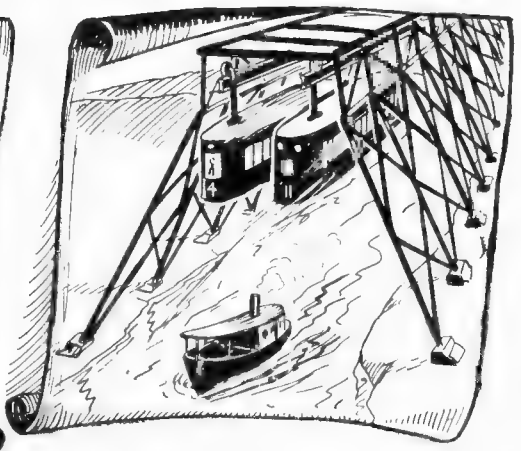
Freak Railways We Have Met



The leap-frog railway was actually used at the Louisiana Purchase Exposition in 1904. Facts beat fiction.

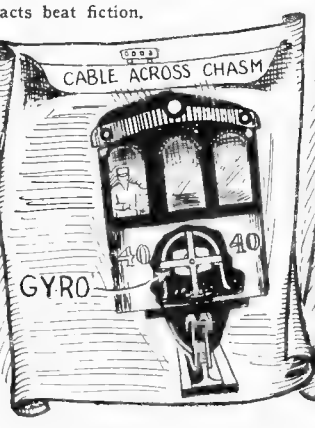


A two-way suspended monorail railway which occupies minimum of space.

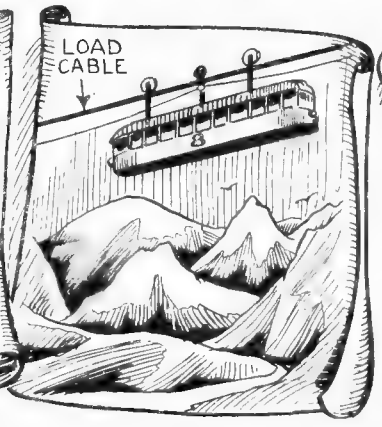


A suspended railway like the one above has been used in Europe for many years.

A freak railway in which expresses "pass through" locals.

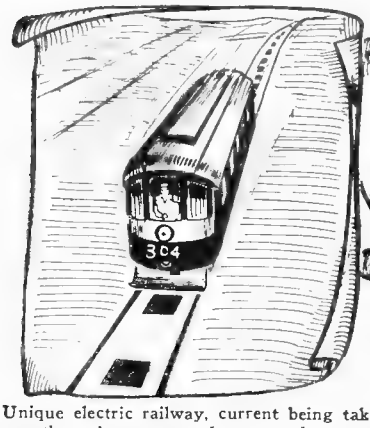


The gyroscopic railway which has been demonstrated by Brennan.

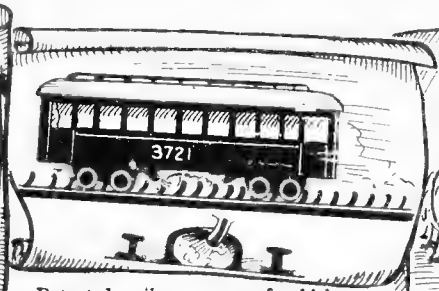


Suspended cable railway, cars being pulled by second cable.

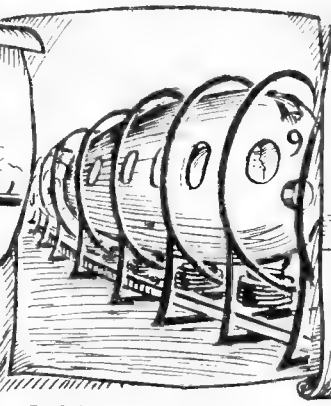
Railway used for many years near New York City. Had rails above and below.



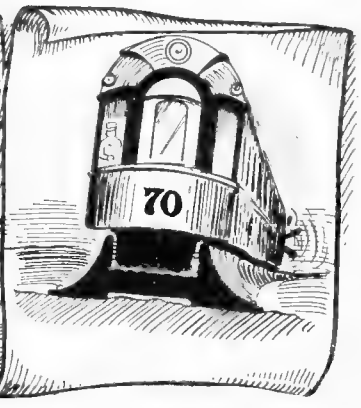
Unique electric railway, current being taken through contact plates as shown.



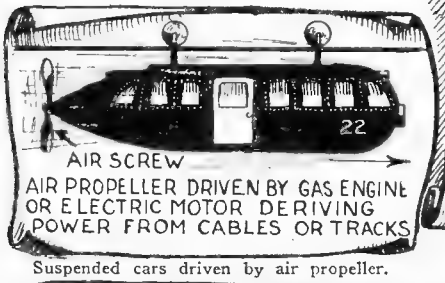
Patented railway, cars of which are propelled by jets of air.



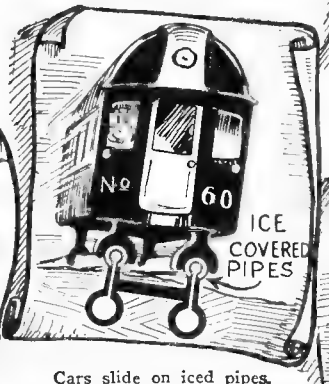
Bachelet levitated train, magnets raise and propel car.



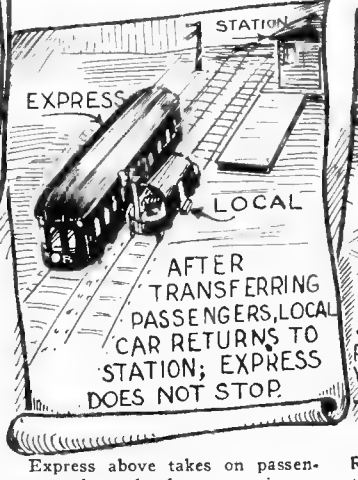
Ingenious railway, cars of which glide on a film of water.



Suspended cars driven by air propeller.

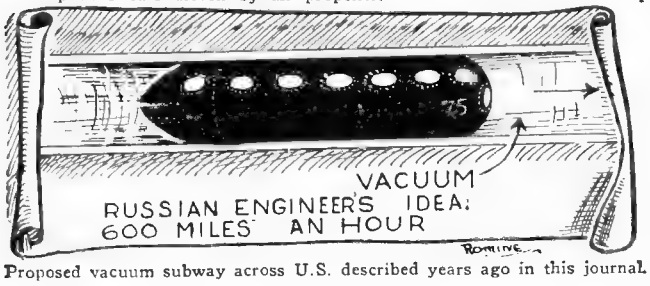


Cars slide on iced pipes.



Express above takes on passengers from local car moving a short distance with it.

Rails simply guide airplane car above; the car raises slightly due to lift of wings.



Proposed vacuum subway across U.S. described years ago in this journal.

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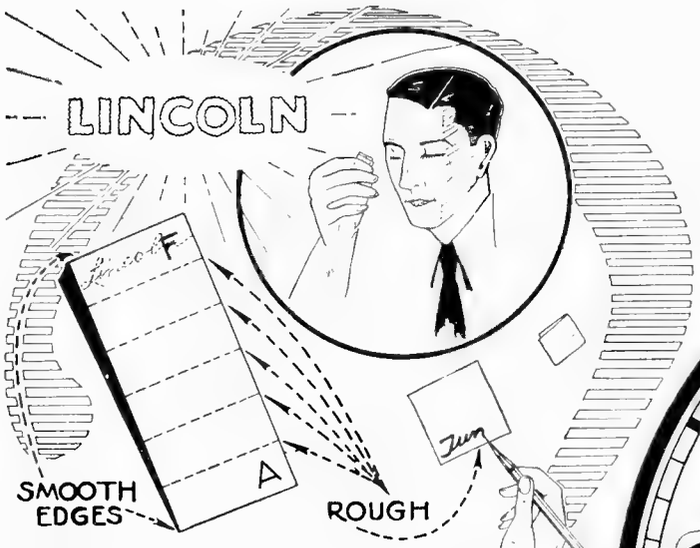
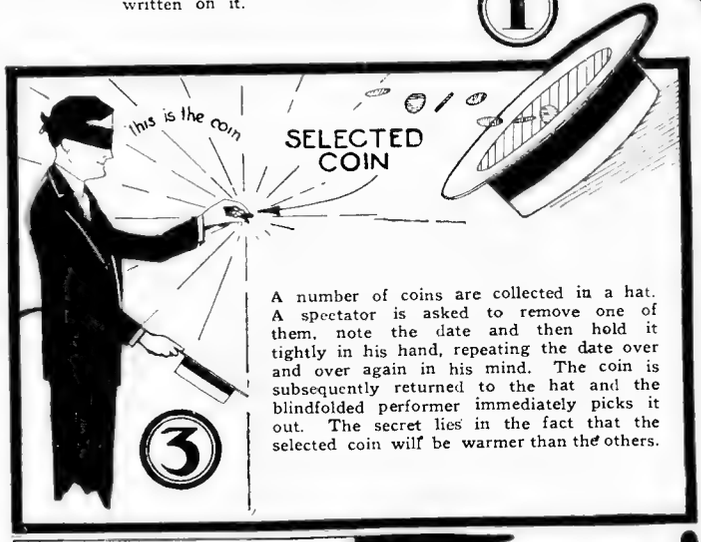
Mind Reading Tricks

By SAM BROWN

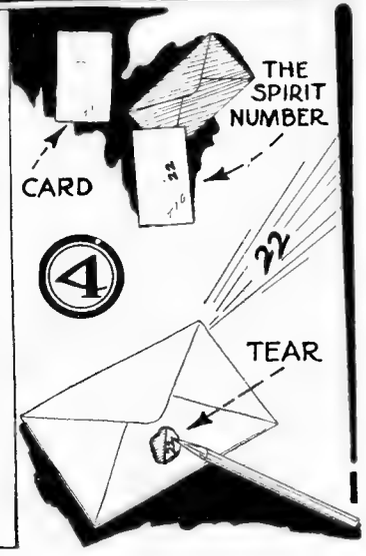


A SHEET of paper is torn into strips by a member of the audience. All of the members must write the name of a living person on one of the slips, but one of the members is to write the name of a dead person on his slip of paper. The papers are folded up and dropped into a hat and the performer, even though blindfolded, selects the slip of the dead person immediately. The secret is simple. Use a ruler to tear the slips. The first and last slips, A and F, will have one smooth edge, the outside edge of the paper. The other slips have rough edges, caused by tearing them. The first slip is destroyed in demonstrating the trick. The dead person's slip is the one having the smooth edge, and the name of a historic figure should preferably be written on it.

The performer, without looking at the face of an ordinary alarm clock, calls the number at which the minute hand has been set. The clock is slightly prepared. The long (minute) hand is set at 12. Then with a knife, a scratch is made vertically across the set key, a little wider at the top than at the bottom. By glancing at the scratch you can tell the number at which the hand is set. Remember that when the clock is placed face down on the table, the numbers run counter-clockwise.



A number of coins are collected in a hat. A spectator is asked to remove one of them, note the date and then hold it tightly in his hand, repeating the date over and over again in his mind. The coin is subsequently returned to the hat and the blindfolded performer immediately picks it out. The secret lies in the fact that the selected coin will be warmer than the others.



A blank card is initialed and sealed in an envelope. Someone is asked to call out a number, then apparently write this number out in free air. Wafting the envelope through the air, the performer opens it and the number is found written on the initial card. The envelope is prepared by tearing a small circular opening in the back as shown. This opening is kept covered by the thumb and, while the attention of the audience is directed to the tracing of the number, the performer secretly writes the number upon the card through the tear. The envelope on being torn open, is crumpled up and thrown away.

TRICKS of a pseudo-scientific nature are coming into great popularity due to the widening influence of psychology, mental telepathy, and allied sciences, and on this page are illustrated a few effects of this nature which will convince the most skeptical. In reality, of course, they are nothing but mere *tricks*, but to the audience they can be made to assume the proportions of an actual demonstration of the new science if clothed with a suitable line of "patter."

For example: In the upper left-hand corner is pictured an effect in which the performer selects from several slips of paper the one slip containing the name of a dead person. That is merely the bones of the trick. The performer must, in his presentation, announce that when the *dead person* slip is placed to his forehead a certain sympathetic bond is established between himself and the "great beyond" which enables him to ascertain when the correct slip is reached or—the slips containing names of living persons give him a sensation of warmth, while the slip on which is written the name of a dead person produces a cold, clammy feeling when applied to his forehead.

In all *mind-reading* tricks the performer must strive to keep his audience away from the mere mechanics of the trick, but subtly moulding their minds into a receptive state through the use of a plausible bit of science. By this means even the simplest effect can be made into something quite impressive. As an instance of this, take the *Blindfold Detection* illustrated in number three. Nothing pretentious in its mechanical make-up, yet the performer can, by touching fingers with the person who held the coin and then finding the coin by means of the personal magnetism still clinging to his fingers, make of it an actual demonstration of a still unexplained science.

In the *Spirit Number* effect pictured at number four the performer is required to make use of a piece of misdirection. When the spectator is asked to trace the number in the air, all attention is focused on him, and the performer takes this opportunity to calmly write the number on the card through a tear in the envelope. In removing the card the performer tears through the previously torn portion, thereby removing the one and only clue as to the modus operandi.

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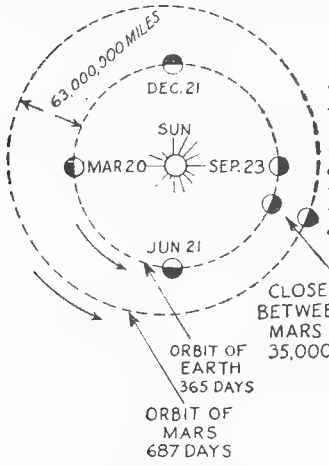
Mars—the Mystery Planet

By W. J. LUYTEN,
OF THE HARVARD COLLEGE OBSERVATORY

IS there any field of science which excites such interest, such an ardent desire for knowledge as does the problem of life outside the earth? The "man in the street" and the astronomer alike unite



The orbits of the earth and Mars are shown in this diagram, as well as the time of nearest approach.

in the wish to pierce the mystery which surrounds the question of extra-terrestrial life, prompted possibly by the hope, or fear, that we Earthlings may be the only intelligent people in creation. And of course, of all the objects on which to speculate about life, the planet Mars easily holds first place. The Moon is too close, so we know too much about it, and the other planets of our solar system are too far away and too little known to be of much use for speculations about life; but Mars, the ruddy planet of the War God, Mars, with its famous canals, is far enough away to be difficult observing, yet close enough to be interesting.

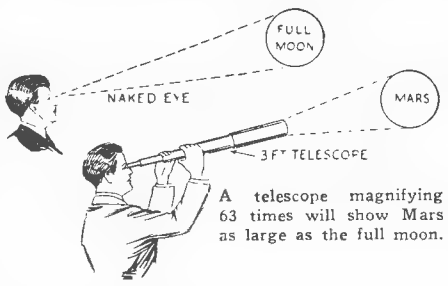
When the question of the possibility of life on Mars is raised, however, it does not mean the same thing to everyone. To the man of science it means any kind of organic life, vegetable or animal, from bacteria and other micro-organisms to the highest (or lowest) forms of civilization. On the other hand, when the "man in the street" speaks of life on Mars he *means LIFE, human* beings, or at least beings sufficiently civilized and developed to have radios, to drive automobiles and to shake cocktails. Bacteria may be of importance here on earth because they can cause diphtheria, typhoid or cancer; they are absolutely devoid of interest across a distance of 50,000,000 miles. Only Martians who have telescopes and who can send and receive radio messages would be of any use to us Earthlings.

Long before the days of accurate scientific observations Mars became an object of particular interest. Fiery red, almost menacing in its savage lustre, and at times the brightest star in the sky, Mars was, from time immemorial, regarded as the symbol of destruction, the personification of the God of War. The unfortunate planet was made the scapegoat of all human crimes and follies; to its pernicious influence were ascribed all disaster, strife, and ruin which befell humankind; it was the most feared, and yet the most worshipped of all the planetary gods. The crimson globe was made the supreme warlord, and it directed all combats; on the battlefields of Marathon, in the pass of Thermopylae, and at the massacre of Trasumene the victims blamed Mars for its barbarism. In the horoscopes which the ancient astronomers cast for their kings and nobles Mars was a most potent influence, almost the most important factor in shaping human destiny. Now that science has destroyed this magic aureole, Mars has nevertheless maintained its position of great interest among celestial objects. The reasons for this are that Mars comes closer to us than any other celestial object except the moon, and is the only planet not continually shrouded in clouds; the only one of which we can study the surface.

Before we enter upon the subject of the possibilities of life it may be well to take stock of everything our telescopes and our calculations have told us about Mars.

If we accept the old Kant-Laplace theory of the origin of the solar system, Mars ranks above the Earth in order of seniority; it was thrown off the primeval nebula before us. It has therefore had more chance to cool off and should be much further developed, especially since it is also much smaller in size. The present state of affairs is that Mars revolves round the Sun in an elliptical orbit varying its distance from the Sun between 128 and 155 million miles, and taking 687 days to complete one round trip.

Inside this elliptical orbit of Mars the Earth is revolving, in an almost circular orbit, taking 365 days to make one round trip. As a result our Earth steps between the Sun and Mars once every 26 months, but the distance between us and Mars at such an occasion varies a good deal and depends entirely upon where in the orbits of Mars and the Earth this event happens. Sometimes the distance between us is no more than 35 million miles, other times it may be as much as 63 million. Unfortunately, the nearest



A telescope magnifying 63 times will show Mars as large as the full moon.

approach between us and Mars always happens when Mars is so far south in the sky that it is difficult to observe from our northern observatories, and as yet there are no powerful telescopes south of the equator. For this reason the recent close approach of Mars (Nov. 1926) was much more favorable than the previous one (in 1924) although Mars now was 7,000,000 miles further away than the time before, but much higher up in the sky.

When at its nearest, Mars appears to us as big as a dime at a hundred yards, or sixty-three times smaller than the full Moon. A telescope magnifying sixty-three times will show it as large as the full Moon, and our most powerful telescopes could probably make it appear forty times larger in diameter than the Moon, or 1600 times larger in surface area. Under those conditions a skilful observer would probably be able to distinguish objects not less than thirty miles in diameter. Manhattan Island would be invisible but Long Island might well be noticed.

But now for Mars itself. It is one of the smallest among planets, being only 4200 miles in diameter (our Earth is 8000). Its bulk is six and one-half times smaller than ours but still seven and one-half times larger than that of the Moon. From the disturbing effect Mars has on the other planets, Le Verrier calculated that its mass is no more than one-tenth of ours. These calculations had required a century's observations, thousands of hours of computation and of discussion and yet an equally precise result was derived later on from four nights' observations of the satellites of Mars, and ten minutes' calculation. But then Le Verrier did not yet know that Mars had satellites. These Moons, two in number, were discovered by Asaph Hall at the Naval Observatory, Washington, D. C., the first one on Aug. 11, 1877, the second one six days later. To make them fit traveling company for the War God, the discoverer named them Phobos (fear) and Deimos (terror) after the two legendary companions of Ares (Mars) in Homer's Iliad. These two Moons belong to the smallest and most interesting celestial objects known; they are both probably not more than 6 and 10 miles in diameter. The innermost of the two Moons revolves around Mars at a distance less than the diameter of Mars above the surface of the planet; the outer one at a distance three and one-half times the planet's diameter, whereas our Moon is thirty times the Earth's diameter away from us. As a result of the small distance the inner moon runs very fast; it makes one complete journey around the planet in seven hours 39 minutes; in less than one-third of the time it takes Mars to turn on its axis. Think of the difference with us: Day and night on Mars last about as long as they do on earth since the Martian 24 hour day is 24 hours 37 minutes and 37 seconds measured in our time; but the inner moon running three times around the planet in one Martian day must rise in the west, dash across the sky and set in the east! The outer satellite behaves more normally; it rises in the east and sets in the west, but takes its time about it, remaining above the horizon for more than two days at a time.

Because these two moons are so close to the surface of Mars, their inhabitants, if they have any, must be enjoying some queer sights. To them the disk of the planet subtends at an angle of 42 degrees, i.e. when it is "Full Mars" for them, Mars shows a luminous disk 7,000 times larger than the full moon and 15,000 times larger than the Sun as seen from that satellite. The full length of the Big Dipper represents about half the diameter of Mars, and Orion's height not more than a third. An eclipse of the Sun seen from there is a real eclipse, lasting over an hour! The outer satellite seen from the inner one, is at best no larger than four minutes of arc (a dime at 12 yards).

Relative sizes of our earth and Mars.

Probably the most remarkable thing about these satellites is that, although entirely unknown before 1877, their existence was predicted by Voltaire in his "Micromegas" and by Swift as early as 1720. In the third chapter of the journey to Laputa, Swift

(*Continued on page* 178)

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Mars as Seen From Its Satellite "Phobos"

(*Copyright 1927 by Science and Invention*)

A view of the planet Mars as it would look from its nearest satellite, Phobos. Seen in this manner Mars is not red as when viewed from the earth with the naked eye. It is, as one observer aptly termed it, an opal, and it surely has some of the qualities of an opal in the diversity of aspect which it shows to the imaginary observer on Phobos. Phobos makes a complete circuit around Mars in seven and one-half hours.

Worthy of note is the constellation Orion, and other bright stars, which appear exactly as they do from our earth. The second satellite is just visible to the left of Mars, in the constellation, Taurus. Note also, that it is not yet "Full Mars," and that the disk of Mars far surpasses the constellation Orion in size. The canals on the Martian surface should also be observed. This illustration originally prepared by the famous astronomer Flammarion.

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Magic Taught in Schools

In Germany There Is a Regular School for Teaching Magic. Those Desiring to Become Professional Magicians Receive Detailed Instruction.

Card tricks are taught to the students in the German magic school in the manner indicated in the photograph above. This school is equipped with a stage, so that the trick can of the trick can first be demonstrated.

In the effect illustrated above one of the students is completely bound to a chair. The tape around his neck is then held by two assistants, and after the screen is closed, the student must produce spirit manifestations.

Students demonstrating newly learned tricks. We see the "thumb tie," "linking rings," and "numbered blocks."

Taking the student behind the scenes, he is instructed in the art of making magical apparatus. At the left there is a cabinet from which the performer will escape. This is accomplished by creeping out through the opening shown. Below: Teaching the Conrad eight-ball trick.

Above a student is giving a demonstration of the Mikado handkerchief illusion. The other students are grouped about and will comment on the defects in the presentation of the trick. Below the photograph shows apparatus being made to order for the magicians.

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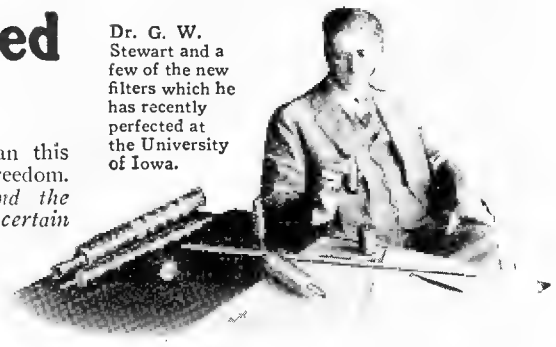
How Sound Waves Are Filtered

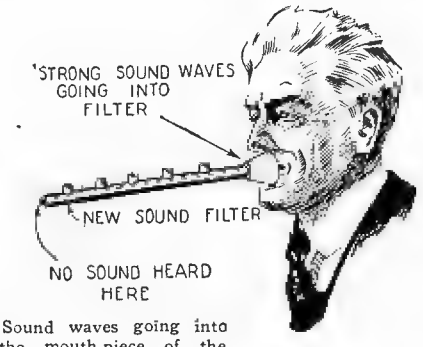
By PAUL WELKER



Dr. G. W. Stewart and a few of the new filters which he has recently perfected at the University of Iowa.

SOUND waves will pass through obstacles to a surprising degree. This fact makes the sound proofing of walls and floors a seriously difficult problem. A portion of a sound wave will pass through any vibratory material, and without a great difference in the amount of transmission between tones of high and of low pitch. An apparatus which will prevent sounds of a predetermined range of tones to pass and yet will give easy transmission to all others seems at first thought almost impossible. But Dr. G. W. Stewart, Professor of Physics of the University of Iowa, has accomplished this feat in an acoustic wave filter.

Listening to the playing of the piano scale through one of these filters gives one an uncanny feeling. The listener can hear the tones distinctly until a certain one is reached and then as the scale is continued he hears only the thumping of the keys. Or one can attempt to speak through such a filter, only to find, for example, that the vowel "e" becomes the vowel "oo."



Sound waves going into the mouth-piece of the filter are entirely changed so that no sound is audible at the opposite end.

Professor Stewart's apparatus is surprisingly simple in form, indeed, so simple that one is inclined to inquire as to why it had previously eluded discovery. Even the inventor did not stumble upon it. The possibility of an acoustic wave filter was suggested by the existence of an electrical filter, and Professor Stewart proceeded to ascertain from a mathematical examination whether or not an acoustic filter was feasible. Then he constructed the filter and verified the predictions of theory. Fig. 1 will show the construction of three general types of acoustic filters. H is a high frequency pass filter and consists of a pipe or conduit containing equally spaced orifices. The sound enters at one end and that not filtered out leaves at the other. It is curious that no one previously had found that such a pipe with holes will refuse transmission of a certain tonal range of frequencies. Fig. 2 shows the performance of this filter. Below a frequency of vibration of approximately 500 or an octave above middle C of the piano, less than one-millionth of the intensity passes. Yet above this frequency, not only to the limit of the piano scale, but to a tone one octave higher than this the sound can pass with great freedom. *The astonishing feature of this and the other filters is that the flow of certain sounds through an apparently unobstructed pipe is effectually stopped.*

The two other types are illustrated as follows: Fig. 3 shows the transmission of the low frequency pass filter designated by L in Fig. 1 and Fig. 4 the corresponding performance of the single band filter, SB in Fig. 1.

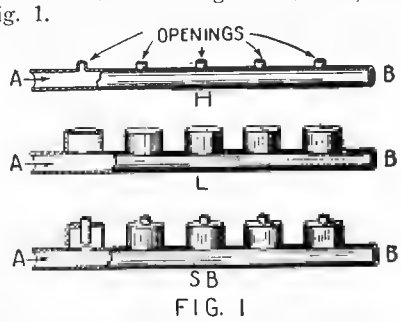


FIG. 1

The general construction of the sound filters are shown above. H, a high frequency filter; L, a low frequency filter, and S.B., a single band filter.

In type L, the orifices are enclosed by chambers of known volumes. In the filter SB, there is in addition a pipe connecting the chamber to the outside.

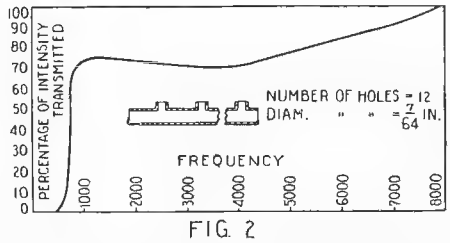


FIG. 2

A graph showing the performance of the filter at a frequency of vibration of approximately 500.

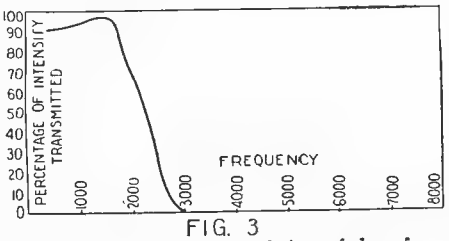


FIG. 3

Curve showing the transmission of low frequency sounds by filter, L in Fig. 1.

The physical action of these filters is complicated. In fact, no physicist could have prophesied their performance by basing his judgment on past experience. It is not difficult to understand why this unanticipated result occurs. Consider a pipe, through which an acoustic wave passes and in which there is a simple orifice, Fig. 5. The full line arrows show the entering wave A and the transmitted wave B, and the dotted arrows indicate the waves A1 and B1 which are caused by the presence of the orifice. The wave A when it reaches the orifice does not merely lose some of its energy to the outside and pass on a remainder. A hole is not that simple. It acts more importantly, as if it had an inertia, thereby setting up reflected waves A1 and B1. Actually, these reflected waves are much more important in the action of the pipe than the relatively small amount of energy that escapes through the orifice. It is easily seen that the waves A1 return some of the incident sound energy and that the wave B1 combines with the remnant of the incident wave to form the transmitted wave B. The actual value of B in a particular case is shown in Fig. 6. The transmission varies in a marked manner with the frequency. If instead of one orfice there are a series of them, the actual reflected waves on the interior are so numerous that they are too difficult to follow. Their resultant action is indicated in the transformation of Fig. 6 into Fig. 2.

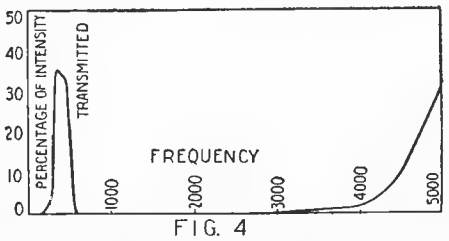


FIG. 4

Showing the performance of the single-band filter, S.B. in Fig. 1.

It is obvious that the combination of waves is so complex that the wave at any point in the pipe between the holes is no longer like the original incident one. An investigation shows that the lack of synchronism between particle velocity of the medium and the pressure, causes a reduction in the energy transmitted.

The action is much similar to an alternating current with which energy may be transmitted or may be made merely to surge backwards and forward without transmission. In an electric lamp bulb there is energy transmitted. But if in the same electric socket there is attached a resistanceless inductance, the power expended on the inductance is zero because the energy merely surges back and forth. In the filters the reduction of transmission to an exceedingly small value is astonishing. *It is possible to take a pipe only a few inches in length and three-fourths of an inch in diameter, and to prevent sound over a range of tones from passing through this apparently unobstructed hole. A sound that would be uncomfortably loud can be reduced to inaudibility.* In a word, this feat is performed by causing the waves to interfere among themselves rather than by the insertion of obstacles. This is not the method used in silencers, and mufflers today, wherein the energy of the sound waves is dissipated through viscosity.

The acoustic wave filter has already demonstrated its usefulness as a research tool. It can be utilized anywhere that such a control of sound waves is desired.

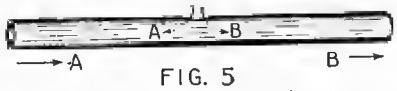


FIG. 5

The underlying principles of the filter are demonstrated in the simple pipe arrangement above.

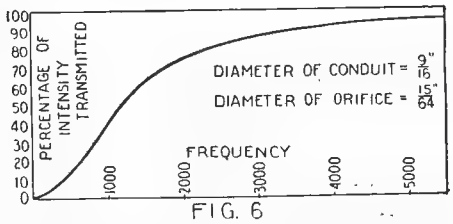


FIG. 6

The actual value of the transmitted sound is shown above. The resultant actions are indicated in the transformation of Fig. 6 into Fig. 2.

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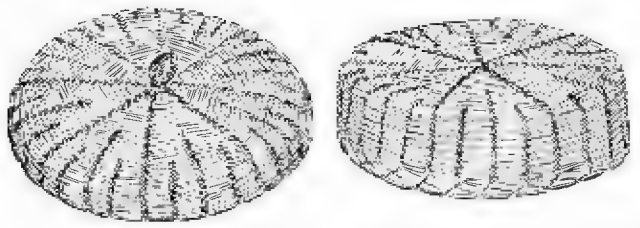
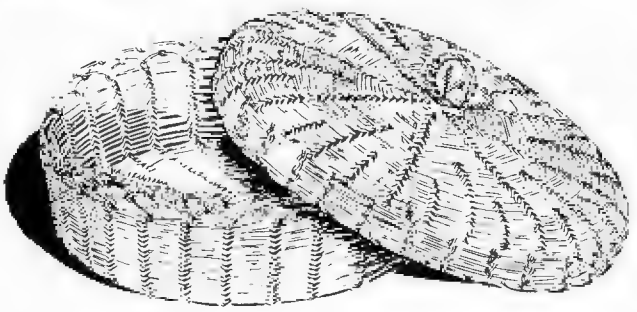
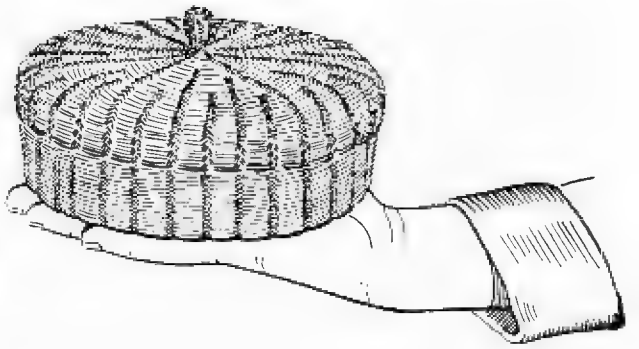
WIREKRAFT—IN

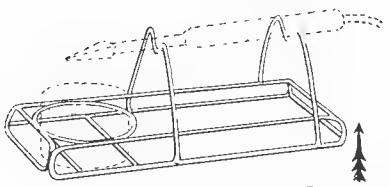


The three illustrations here show the first prize - winning model in this month's Wirekraft Contest. Brass and nickeled wire were used in its construction.



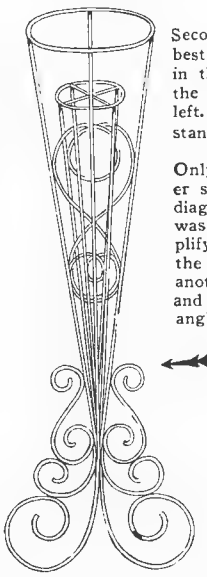


In the Wirekraft Contest awards for this month the first prize was given to Michael J. Thelen of Chicago, Ill., for a basket. This basket was made of brass and nickeled wire to get a contrast color effect. The wire was woven very tightly so that the article presented not only utilitarian attributes, but also the artistic effect so much desired. This article is not as heavy as one might expect it to be. It will stand more than the usual abuse.



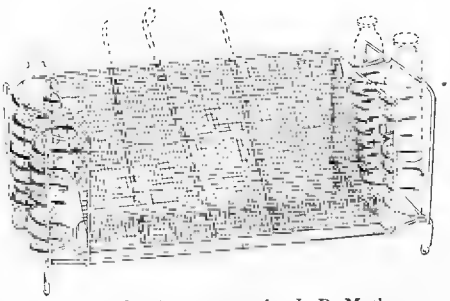
Fourth prize—$20.00 was won by Jack Egemeier of Ossining, N. Y. It will be observed that two brackets rise up to hold the soldering iron. A circular frame may be found at one end of the holder for the can of soldering paste.

At the left we have a combination soldering iron holder and a receptacle for the-soldering paste can.

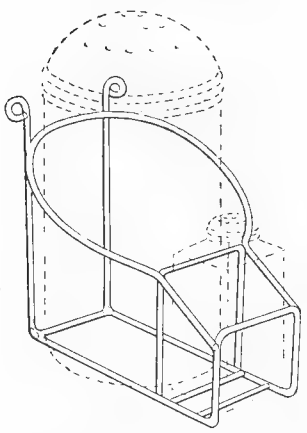


Second prize—$50.00. The best artistic effect entered in this month's contest is the one illustrated at the left. This is a flower stand made entirely of wire.

Only one-half of the flower stand is shown in the diagram at the left. This was done so as to simplify the construction. In the article itself there is another group of spirals and another scroll at right-angles to the scrolls and spirals shown.



Fifth prize—$15.00 was won by J. P. Mathews, of Vienna, Va., who constructed the dental tool holder indicated in the above diagram. The tools are placed on the wire gauze screening and bottle receptacles are found on both sides.

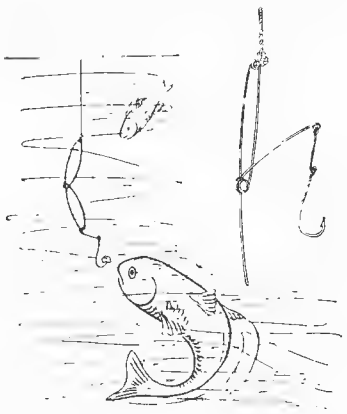


At the left we have an ingenious device which can be used in the kitchen. This is an article designed to be hung on the wall and provided with a pair of loops for the screws.

Third prize—$25.00 was awarded to W. T. O. Dogherty of Tracy, Calif., for the kitchen salt box holder combined with the pepper box receptacle. The article can be enameled white to conform with the other kitchen appliances. Eighth prize—$5.00 was awarded to C. Daggetts, Palisades Park, N. J., for his combination trousers and coat hanger indicated in the drawing below.

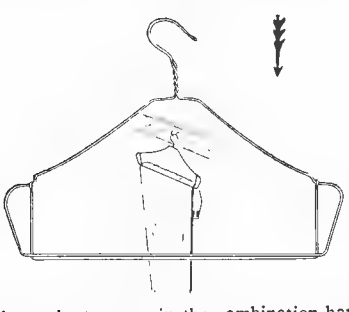
THE drawings on this page appear in line. Actually, all of the articles were photographed and the photographs were gone over with ink after which the photos were bleached. In this way the details of the prize-winning articles are brought out and they can be duplicated by other Wirekrafters with ease.

It is important that those entering models in the Wirekraft Contest attach their names and addresses to every model.

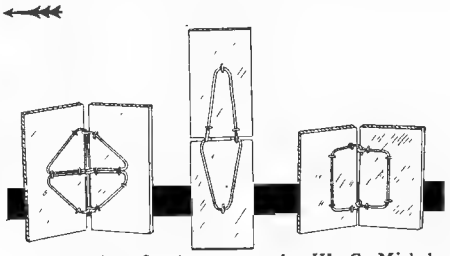


Sixth prize—$10.00. Estel Merryman of Richmond, Ind., made the fish hook illustrated in the diagram above. This fish hook is of the self-hooking type. The instant that a fish nibbles on a bait it releases the hook which snaps upward imbedding itself in the upper jaw.

Seventh prize—$7.50. By the aid of the device illustrated in the diagram at the left one can convert the ordinary bottle into a milk pitcher. This article was constructed by L. Kaler of West Philadelphia, Pa.



To hang the trousers in the combination hanger here shown, one places the trousers over the inside loop and their weight holds them securely in place.



Ninth prize—$3.50 was won by W. C. Michel of Jersey City, N. J., for the three samples of hinges here shown.

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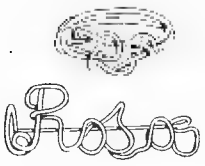
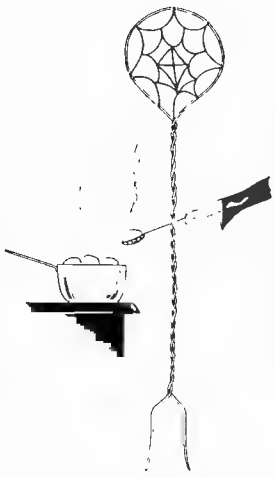
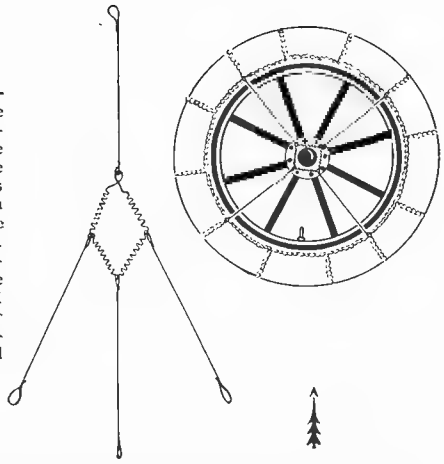
$3,000.00 PRIZES



Tenth prize—$2.00. was won by Ben V. Kitchel of San Antonio, Texas, for the pin and ring here shown. Both are constructed of one piece of wire. bent to the form here illustrated. Care must be exercised in constructing articles of this nature, otherwise they will appear amateurish.

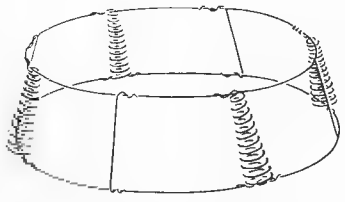


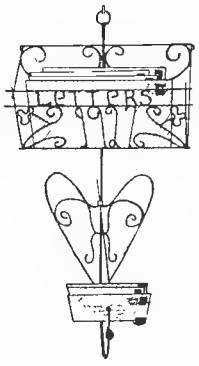
Fifteenth prize—$2.00 was the award decided upon for the article indicated in the diagram here. This is a combination fork and ladle made by Ben V. Kitchel of San Antonio, Texas. The ladle at one end can be used for handling dumplings, potatoes and the like.



Thirteenth prize—$2.00. Automobile tire chains have the peculiar property of rattling against the fenders. This rattle can be relieved by building an anti-rattler as indicated above. The diamond shaped center portion is made of spring brass. The spring takes up the slack.

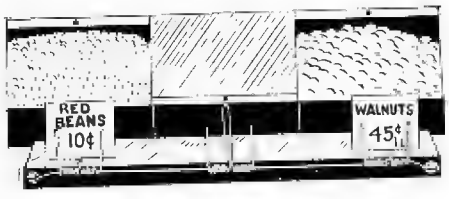
Fourteenth prize—$2.00. Here we have a waffle iron holder constructed entirely of wire and provided with springs to take up the shock of closing the iron and yet to make the article more rigid. The device was made by W. B. Cowan of Memphis. Tenn.





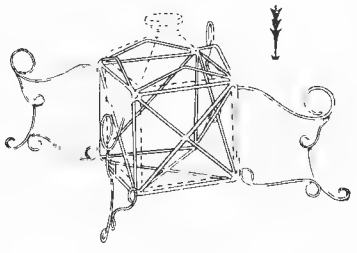
Twelfth prize—$2.00. The letter holder and bill or letter file combination indicated in the diagram at the left was constructed largely of bus bar wire. This makes a very serviceable article which is quite rigid. Unfortunately its designer did not attach his name to the article. notwithstanding the fact that the rules specify that all models should be tagged.

Eleventh prize—$2.00 was awarded to C. B. Lane of Fort Worth. Texas. for the price tag holder indicated in the diagram below. This rides upon a wire and serves as a holder for small cards.



Sixteenth prize—$2.00 was awarded to Urban Otten, of Cincinnati, Ohio. for an article also constructed entirely of bus bar. This is an artistic holder for an ink bottle, the style of which is presented in the diagram below.

The price tags can be tilted down if a commodity runs out. The tag holders are attached to a stretched wire.



RULES OF WIREKRAFT CONTEST

THIS is a wirekraft contest. Hence wire is to be used in the construction of all of the models entered in this contest.

The size of the wire to be employed is limited. The heaviest wire must not be larger than No. 8 American or B and S gauge, and the smallest no smaller than No. 30 B and S gauge—or (for foreign countries not having these exact sizes), the nearest available equivalent.

No. 8 B and S gauge is .12849 inches in diameter or 3.264 millimeters. Its nearest equivalent in the Birmingham or Stubs iron wire gauge is No. 18. In the Stubs steel wire gauge it is No. 30; in the British Imperial Standard it is No. 10. The nearest wire to No. 30 B and S gauge which is .01002 inches or 2546 millimeters in diameter is No. 31 in the Birmingham or Stubs iron wire gauge. In the Stubs steel wire gauge it is No. 80; in the British Standard it is No. 33.

The builder may avail himself of the opportunity of using any intermediate sizes of wires between No. 8 and No. 30. B and S gauge.

The wire may be copper, brass, iron, steel, or these materials coppered, tinned, nickel-plated, or galvanized, or the wire may consist of an alloy. Any kind of wire available on the market may be employed.

It is preferable to use non-rusting wires. The publishers will not be responsible for the rusting of any model. To protect wire which rusts easily or for color effects, the models may be painted, lacquered, varnished or otherwise covered.

Any additional decorations or accessories may be employed to enhance the effect. (Example: Silk on a lamp shade; glass in decorative fixtures; electric motors for operating mechanisms, etc.)

Only those portions actually constructed of wire will be judged.

(Example: A reed basket is suspended from a wire chain. The basket not being made of wire is NOT considered. On the merits of the chain only will the prize be awarded.)

Wires may be twisted, spliced, soldered, welded or bound together. Wire may be used to bind other wires together. If soldered a non-corrosive soldering flux should be employed.

There is no limit to the size of the models which may be entered nor to the number of entries which any maker may submit during any calendar month.

In every case the model must be forwarded express prepaid to SCIENCE AND INVENTION Magazine. It should be tagged with name and address of the maker. who will prepay charges if model is to be returned.

The first prize will always be awarded to a model possessing the greatest utilitarian merits. This must be an object NOT found on the market today.

The second prize will always be awarded to an object possessing the best decorative, artistic or constructive effect. It may be a replica of an existing object or a model of an imaginative object or effect.

The remaining prizes will be judged from either one or the other viewpoints at the discretion of the judges.

All models may remain at the office of this publication until the close of the contest at the discretion of the editors.

This contest starts January 1st, 1927, and will terminate January 1st, 1928.

This is a monthly contest lasting for twelve months. each monthly contest closing on the first of the month following dates of issue. Thus the contest for the month of May, 1927, will close June 1st, 1927. Winners for May will be announced in the August Issue.

$3,000.00 In Prizes Arranged in Monthly Awards

First Prize	$100.00
For Utility Only	
Second Prize	50.00
For Artistic. Decorative or Constructive Effect—may be a replica or model of some imaginative or existing object.	
Third Prize	25.00
Fourth Prize	20.00
Fifth Prize	15.00
Sixth Prize	10.00
Seventh Prize	7.50
Eighth Prize	5.00
Ninth Prize	3.50
10th to 16th Prizes of $2.00 each ...	14.00
Total	$250.00

Tools Required

THE tools required for the construction of Wirekraft articles may be found in the Dec. issue of this publication, a reprint of which will be sent free upon request. The following tools may be used advantageously:

1 pair flat-nosed pliers. 1 pair round-nosed pliers. 1 wire cutter, 1 hacksaw, 1 small vise. 1 soldering iron.

The materials which are necessary are:

Solder. soldering paste or flux, nails. one piece of wood, and most important of all, wire of the sizes specified in the contest rules and regulations.

If the builder decided to weld his wires together, a small welding transformer or a storage battery may be used for this purpose. For the formation of long cylinders, a coil winding machine or a lathe may be advantageously employed. Toy motors for the operation of any devices constructed of wire could of course be procured and added to the model and the addition of miniature sockets and bulbs to illuminate the interior of any buildings constructed of wire might also find a place in some of the constructions.

Address all entries to
Editor Wirekraft

SCIENCE & INVENTION MAGAZINE
230 Fifth Avenue, New York City

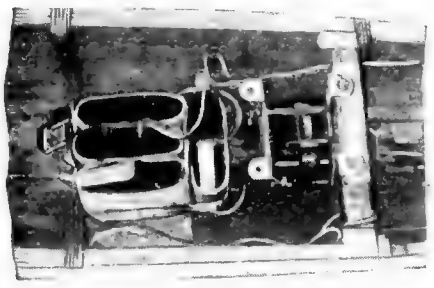
www.americanradiohistory.com

MATCHCRAFT---$100.00 Awarded Monthly

FIRST PRIZE $50.00

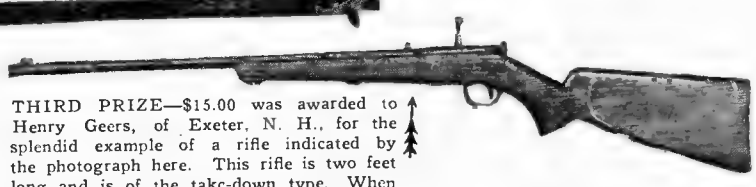
That the matchcraft contest is still popular is indicated by the photographs on this page. At the left we have this month's first prize model which was awarded $50.00. The model was built by Mr. Willie Ryan of New York City. The vessel is thirty inches long over all. Ribs made of several layers of matches glued together were first cut to the desired shape and then matches were glued in place as the planking, which was sandpapered, and then painted. This model is impervious to water and will float to the water line. An electric motor is found within the vessel and four flash-light batteries serve as the source of current supply. The photograph at the extreme left shows how the motor is mounted in the vessel. A switch at the stern closes the circuit, and in this way the motor is under constant control. The vessel itself travels at a good rate of speed. A comparative idea of its size may be gained from the photograph at the left, where the yacht is being held by Miss Estelle Mogel.

The photograph below shows how the motor and batteries are mounted amidships in the first prize winning model in this month's contest.



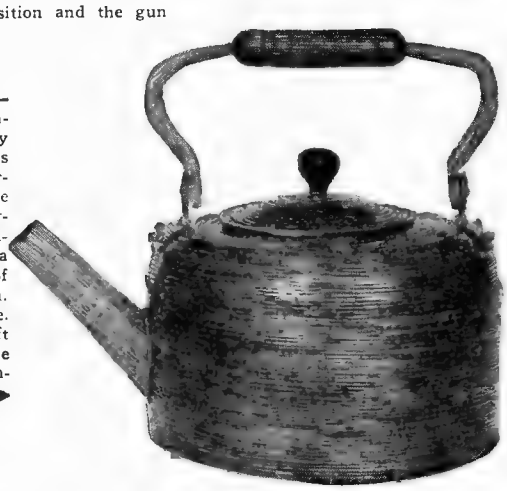
Extreme care and a great amount of patience was necessary in constructing the full-size pail indicated in the two photographs below. It will be observed that each match had to be bent to make it conform with the desired shape.

SECOND PRIZE—$20.00 was won by Eugene Jefferies for the pail illustrated in the two photographs above. Both are views of the same pail but the views were placed as you see them to show the construction.

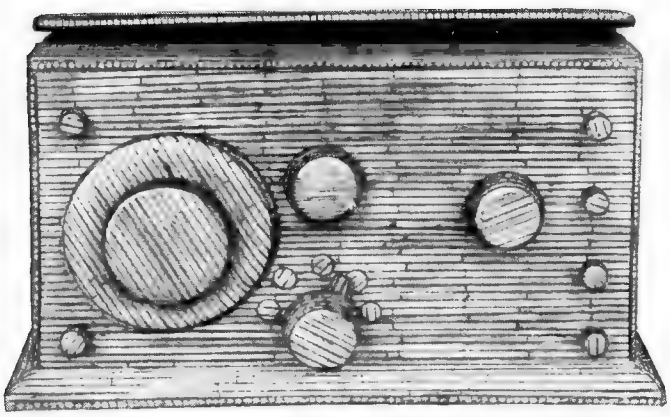


THIRD PRIZE—$15.00 was awarded to Henry Geers, of Exeter, N. H., for the splendid example of a rifle indicated by the photograph here. This rifle is two feet long and is of the take-down type. When the bolt is drawn backward a wooden pellet can be inserted, the bolt can then be returned to its former position and the gun fired.

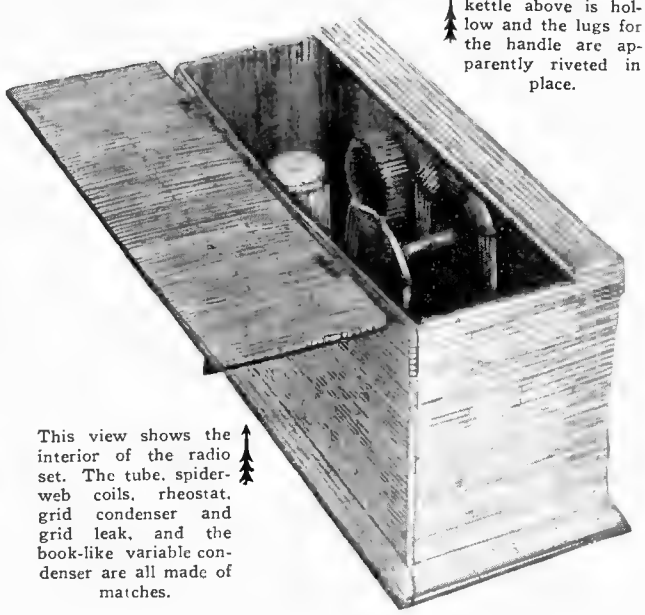
FOURTH PRIZE — $10.00. Lovers of matchcraft art are repeatedly sending in new examples of bent matchcraft articles. The kettle at the right was made by Warren C. Brown of Ossining, N. Y. This is a splendid example of matchcraft construction. The kettle is normal size. Both the pail at the left and the kettle at the right are hollow in construction.



The spout of the kettle above is hollow and the lugs for the handle are apparently riveted in place.



FIFTH PRIZE—$5.00 was won by Lawrence Deye of Cincinnati, Ohio, for his model of a radio set. The front of the cabinet with its tuning dials and controls is shown in the photograph above. The switch-blade is also of matches.



This view shows the interior of the radio set. The tube, spider-web coils, rheostat, grid condenser and grid leak, and the book-like variable condenser are all made of matches.

Rules for the Matchcraft Contest appear in this issue on page 180

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MAGIC BY "DUNNINGER"

HIPPODROME Tonight
DUNNINGER
Joe Dunninger Tells How Prince Got Trick to Show Home Folks
DUNNINGER AMAZES TRIBUNE EMPLOYEES IN DEMONSTRATION
DUNNINGER
HYPNOTIST RULES SUBJECT BY RADIO
Reads Mayor's Inner Mind

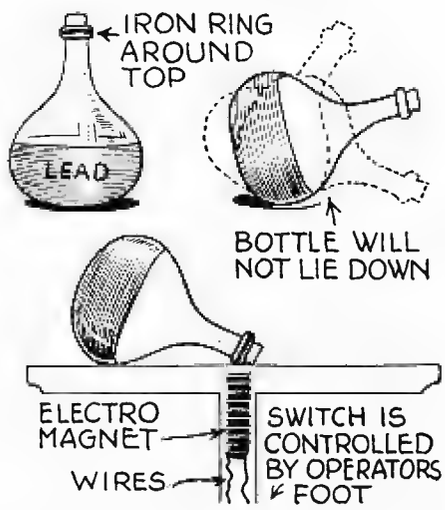
THE MAN WHO MYSTIFIED

Pres. Coolidge
Prince of Wales, Ex-President Harding, Taft, Roosevelt, and other celebrities
Writes Exclusively for
SCIENCE AND INVENTION

Folks Are Mystified Yet Delighted by This Man!
DUNNINGER ASTOUNDS COMMITTEE IN LIBRARY TEST OF MIND READING
Mind You! The Mind Reader Really Read the Mayor's Mind!
DUNNINGER DRAWS MORE BIG CROWDS
Dunninger Will Attempt To Hypnotize Patient, 10 Miles Away, by Radio

NO. 51 OF A SERIES

The Yogi Bottle

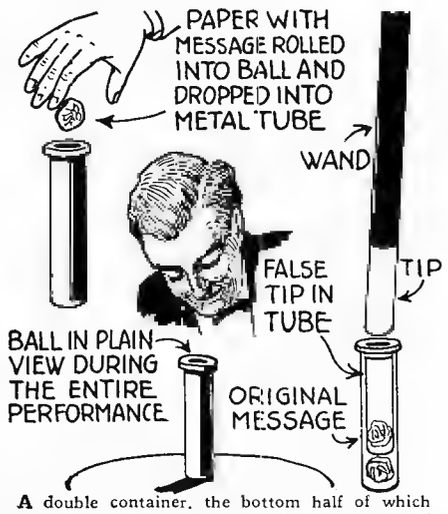


This trick in effect is similar to the imp bottle trick except that the bottle has a cork in the top and consequently cannot be weighted. It responds to the master's command because of the electro-magnet.

UNDOUBTEDLY the readers are familiar with the old imp bottle trick. When the performer took the bottle, he could lay it flat with comparative ease. Others could not. These bottles were weighted at the bottom. When grasped by the performer, he permitted a small piece of lead to drop down into the neck of the bottle, thus counterbalancing the weight in the base. In the present version, a much larger bottle is employed, the mouth of which is closed by a cork stopper. The performer steps on a button controlling a source of electric supply to the electro-magnet which attracts the iron ring around the mouth.

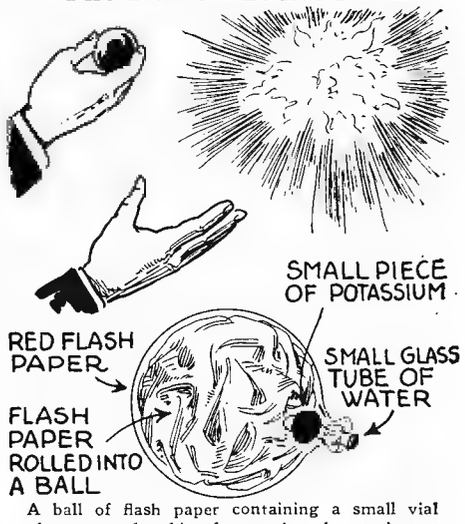
Mind Reading

THE wizard requests the spectator to write a question upon a small piece of note paper, roll it into a ball and drop it in a small tubular container. The ball is forced into the bottom of the container with the magician's wand. The wizard invites the spectator to insure himself that the paper is in full view at all times. While the examination is taking place the question is answered. The effect is produced by the aid of a double wand tip. The real message is removed from the container with the wand and another piece of paper rolled up and previously placed in the false bottom of the container is the one which is held in full view by the spectator.


PAPER WITH MESSAGE ROLLED INTO BALL AND DROPPED INTO METAL TUBE
WAND
FALSE TIP IN TUBE
TIP
BALL IN PLAIN VIEW DURING THE ENTIRE PERFORMANCE
ORIGINAL MESSAGE

A double container, the bottom half of which contains a piece of paper and the upper half of which holds the message is the secret for performing the mind-reading experiment here described.

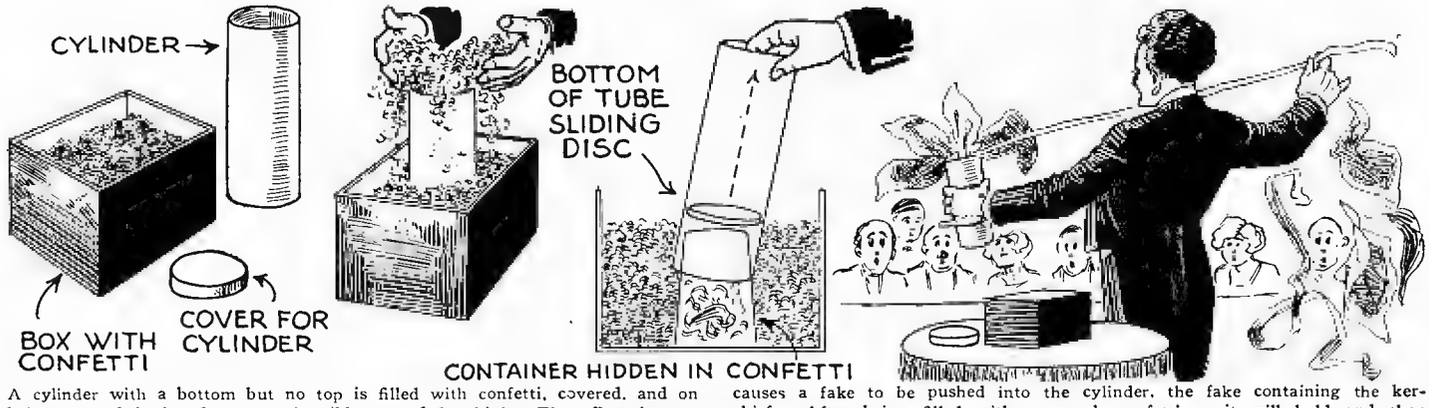
The Demon Billiard Ball



A ball of flash paper containing a small vial of water and a bit of potassium bursts into a flame when the ball is tossed into the air. This produces a spectacular closing stunt for the billiard ball trick.

AFTER presenting a series of tricks with billiard balls, the magician tosses one of the balls into the air. In mid-air it bursts into a flame and vanishes completely. In preparing for this trick the magician rolls a sheet of flash paper into a tight ball and then covers this with another sheet of paper colored red and as nearly like the color of the billiard ball as he can secure. A slight difference in color will scarcely be noticed. A small, thin glass tube filled with water is then inserted into the ball and a relatively large piece of potassium is so placed that the water from the bottle will immediately act on it. The bottle is broken as the ball is tossed in the air. Exercise great caution.

The Tube of Plenty



A cylinder with a bottom but no top is filled with confetti, covered, and on being opened is found to contain ribbons and kerchiefs. The effect is produced by having a cylinder with a sliding bottom. This cylinder is stood up in the middle of a box of confetti and pushed down into it. This motion causes a fake to be pushed into the cylinder, the fake containing the kerchiefs. After being filled with as much confetti as it will hold and then covered, the cylinder is reversed. A few mystic passes are then made, the cover removed and the handkerchiefs withdrawn.

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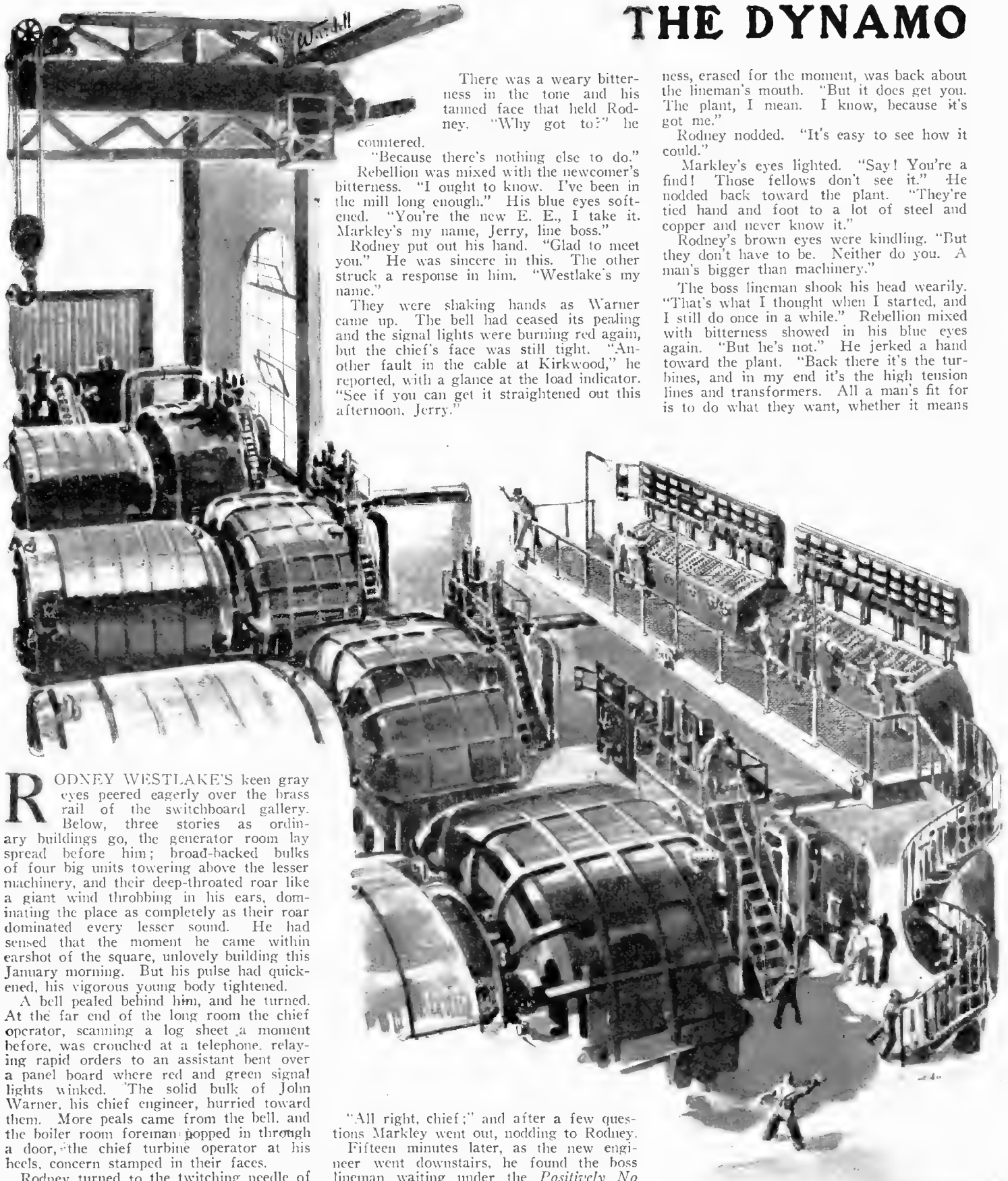
THE DYNAMO



RODNEY WESTLAKE'S keen gray eyes peered eagerly over the brass rail of the switchboard gallery. Below, three stories as ordinary buildings go, the generator room lay spread before him; broad-backed bulks of four big units towering above the lesser machinery, and their deep-throated roar like a giant wind throbbing in his ears, dominating the place as completely as their roar dominated every lesser sound. He had sensed that the moment he came within earshot of the square, unlovely building this January morning. But his pulse had quickened, his vigorous young body tightened.

A bell pealed behind him, and he turned. At the far end of the long room the chief operator, scanning a log sheet a moment before, was crouched at a telephone, relaying rapid orders to an assistant bent over a panel board where red and green signal lights winked. The solid bulk of John Warner, his chief engineer, hurried toward them. More peals came from the bell, and the boiler room foreman popped in through a door, the chief turbine operator at his heels, concern stamped in their faces.

Rodney turned to the twitching needle of a load indicator. It was a surge—two thousand k. w. in lost load; and a look, part amusement, but more pity, came over his face. Those roaring units dominated these men, too, and the overalled figures scurrying about like obedient Lilliputians on the floor below.

A tall man shod with clinking lineman's spurs had come into the room, looked about, and was pausing beside Rodney. "Same old story," he remarked. "Everybody's got to jump and run when they want anything."

There was a weary bitterness in the tone and his tanned face that held Rodney. "Why got to?" he countered.

"Because there's nothing else to do."

Rebellion was mixed with the newcomer's bitterness. "I ought to know. I've been in the mill long enough." His blue eyes softened. "You're the new E. E., I take it. Markley's my name, Jerry, line boss."

Rodney put out his hand. "Glad to meet you." He was sincere in this. The other struck a response in him. "Westlake's my name."

They were shaking hands as Warner came up. The bell had ceased its pealing and the signal lights were burning red again, but the chief's face was still tight. "Another fault in the cable at Kirkwood," he reported, with a glance at the load indicator. "See if you can get it straightened out this afternoon, Jerry."

"All right, chief;" and after a few questions Markley went out, nodding to Rodney.

Fifteen minutes later, as the new engineer went downstairs, he found the boss lineman waiting under the *Positively No Admittance* sign in the entrance.

"Got a place for lunch?" he asked.

Rodney shook his head.

"Good! I owe you an explanation." Markley led the way into the winter wind. "About what I said up in the switchboard gallery."

"Yes?" Rodney prompted. He was aware again of a kindred interest between himself and this new acquaintance.

"Maybe I shouldn't have said it, you just starting here." The suggestion of bitterness, erased for the moment, was back about the lineman's mouth. "But it does get you. The plant, I mean. I know, because it's got me."

Rodney nodded. "It's easy to see how it could."

Markley's eyes lighted. "Say! You're a find! Those fellows don't see it." He nodded back toward the plant. "They're tied hand and foot to a lot of steel and copper and never know it."

Rodney's brown eyes were kindling. "But they don't have to be. Neither do you. A man's bigger than machinery."

The boss lineman shook his head wearily. "That's what I thought when I started, and I still do once in a while." Rebellion mixed with bitterness showed in his blue eyes again. "But he's not." He jerked a hand toward the plant. "Back there it's the turbines, and in my end it's the high tension lines and transformers. All a man's fit for is to do what they want, whether it means

"Rodney tingled. They were asking for help now—these roaring arrogant bulks . . . After all their ruthless domination; he could give it . . ."

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TERROR— By CHARLES MAGEE ADAMS

his time or life or anything. You saw what happened when that surge came along."

Rodney frowned with a tinge of impatience. "But that's only because they let the plant lick them. They don't have to." His eyes were eager and challenging. "No turbine's going to lick me."

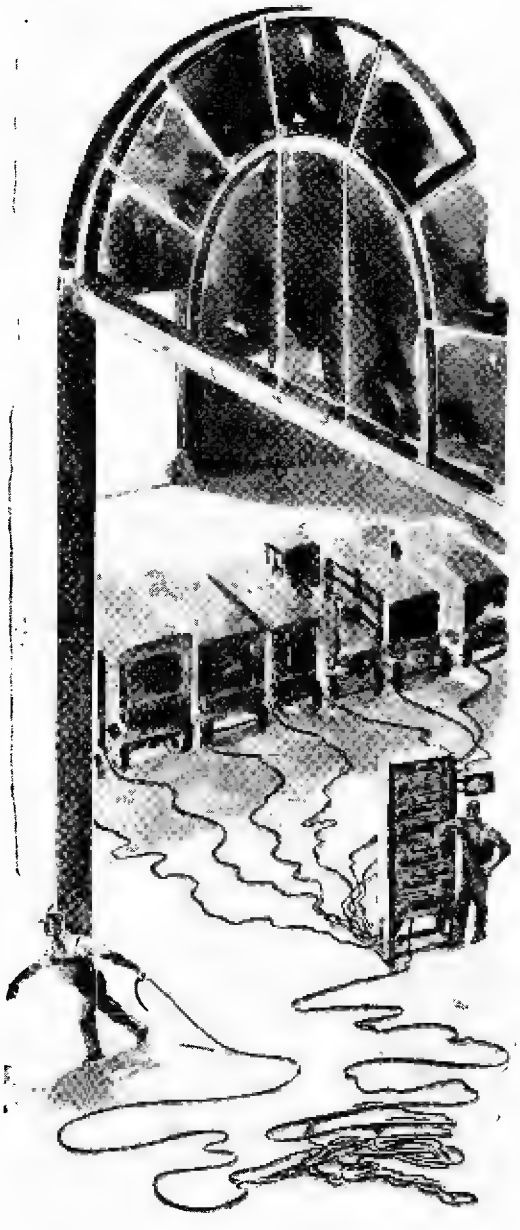
Markley smiled wanly. "Luck to you. But it can't be done. The only way out is to quit." They had reached a little restaurant tucked between two blank-walled warehouses, and he brightened. "Here's the Greasy Spoon though. Let's eat and forget about it. In the meantime I'm darned glad to know somebody that talks my language."

* * *

Rodney shook the sweat from his eyes with a jerk. It was a month after he had come to Arlington, and No. 2 was running 3.4 degrees too hot. "When did you notice it first?" he shouted through cupped hands three inches from the ear of Dick Brinker, its operator.

The little stoop-shouldered man drew back. "Mason noticed it when he started her up at five o'clock." His low colorless voice carried clearly through the din.

Rodney looked at the indicator panel again. "Must be in the cooling system." He was heading toward the door when Brinker plucked at his sleeve.



"Suppose you can fix it?" he asked. "I ain't never had to shut her down."

There was that in his washed-out blue eyes that suggested the anxiety of a devoted servant, and Rodney pitied the little man. These teeming masses of steel and copper had mastered him, mastered all the Lilliputian figures who stood watch at ammeters and vacuum gages, patiently ready to gratify every desire. But he would master them; make them subject to his will; and the eager urge for conquest grew the more tingling as he sensed the measure of submission their might demanded.

It was not till nine o'clock that night, after fruitless tests and sandwiches in lieu of dinner, that he discovered an auxiliary steam line parallel with No. 2's air intake was responsible for the overheating.

"That is, if No. 1 doesn't decide it needs a new bob, or No. 4 doesn't pout for another lump of sugar," he qualified a request for Elizabeth Melvin's company at a feature picture.

The girl regarded him through the cashier's wicket in the main office with friendly gray eyes. "Why, of course," she agreed. "I know your work has to come first."

Rodney's smile faded. "It shouldn't," he countered. "A man's bigger than machinery."

She nodded. "Mother used to tell dad that." Her eyes misted. "He was killed at the old First street station. But don't you think it's better just to let yourself be part of it? Dad used to feel that way, and that's what I tell myself when things pile up here."

There was a clear serenity in her face that reminded Rodney of John Warner, and he pocketed his pay check a bit impatiently. It was well enough to submit through choice or lack of power to resist, but there was no need to make a virtue of it. This was merely gilding the facts, and Rodney had no inclination to do that or even dodge the issue.

Warner had sent him to the turbine room a bleak afternoon late in March to remedy a hot coil on No. 3, and Rodney, as always, found a keen pleasure in the knowledge that he at least was no abject servant to these arrogant bulks. He had brought the coil back to normal and, shouting some instructions to the operator, was starting toward the door, when there came an upheaval of sound that dwarfed the engulfing din—seemed to shake the building to its very foundations.

Rodney whirled about. Something shrieked viciously past his head and buried itself with a clang in the casing of No. 3's generator. A white, swiftly rising cloud enveloped the turbine end of No. 2, but through it he could make out a torn, writhing mass where the thick, high-pressure line broached the boiler room wall, and beyond, not where Dick Brinker had been standing a moment before, but a dozen feet away, a crumpled, struggling heap.

No. 3's operator shouted something about a valve and started at a run toward the writhing mass. But Rodney, seething with sudden fury, sprang forward through the scalding cloud to where Brinker lay. His face was chalky and the torn flesh ghastly red where the shoulder of his jumper had been, as Rodney stooped over him.

"Easy!" he shouted, above the shriek of steam, as the operator struggled to rise. "I'll get you out."

But Brinker tried to push him away. "The valve!" he burst out, that look of a devoted servant stronger than the pain in his eyes. "Turn it off! Tell 'em t' start up No. 4!"

Rodney swore. No. 1's operator dashed past, and he jerked him to a halt. "Here!" he ordered. "He's hurt!"

The man merely shook himself free and darted around the end of No. 2. Brinker was babbling about the valve again. Lights were winking through the thickening fog; bells pealing frantically above the shriek of steam; and men running, operators, boiler attendants, even the solid bulk of Warner. Rodney laid hold of two more, but they, too, broke away and dashed on. He stooped again over the limp figure.

"We'll lose the load," Brinker protested weakly.

"You fool! Damn the load," Rodney snapped, and lifting the little man, carried him past the scarred bulk of No. 3 to the safety of the entrance.

The fury in him had mounted till he was quivering with it. Not content with mere domination, must the roaring arrogant bulks also demand the very lives of these men who served them? And the first thought, even of Dick, was for them. Working desperately to stanch the flow of blood, he looked up ten minutes later and confronted John Warner with blazing eyes.

"Isn't a man's life worth more than the machinery around here?" he flung out.

Warner looked at him, surprise mixed with disappointment in the stiff gravity of his face, then stooped over Brinker. "It's all right, Dick," he said comfortingly. "We got the valve shut off and No. 4 on the line. Sorry it caught you."

"Sorry?" The word crackled. "Even in France they had time for the wounded, and you—" Rodney's face was white, twitching. "You'd let a man die while you take care of those damned turbines."

Brinker had relaxed, an odd peace in his pain-twisted face; and Warner was straightening, gray eyes patient. "You haven't been with us long, Rodney," he said quietly. "Our first duty just has to be to the plant. You'll understand one of these days."

Rodney's jaw set. "I understand now," he snapped, making way for an ambulance surgeon and stretcher bearers.

It was barbarity—nothing else—these domineering, insatiable masses of steel and copper demanding human sacrifice, and these men, tied hand and foot—Jerry Markley was right—giving it unquestioningly. In the poleyard he found the one person who could understand, and poured out his resentment in a scorching stream.

"Why, Dick's a hero," Jerry declared with a wry smile, when he finished. "Not as much of one as if he'd been bumped off, but worth a Croix de Guerre or D. S. C." His eyes were bitter. "That's what it'll do for you if you give it half a chance."

Rodney's mouth was hard. "Here's one it'll never get," he retorted. "I'm going to lick it."

Jerry shook his head. "It can't be done, Rod." His mouth was weary. "All you can do is get out."

Rodney's eyes glinted stubbornly. "You're wrong," he snapped. "It can be done, and I'm going to do it."

He knew now the conquest that lured him on would be no gay adventure; instead, a prolonged, merciless struggle demanding the uttermost of strength and stamina. But it could be won—must be won, if the tyranny of those roaring, relentless bulks over the men who should be their masters, was to be broken. He kept this fixed unshakably before him, even as he worked till midnight replacing the high pressure line on No. 2.

Warner paused a morning three weeks later, after some routine instructions, and his face took on a look of concern. "There's something else I'd like you to work at whenever you get time, Rodney."

He was leaning forward gravely. "We're running our auxiliaries off the main buses, you know — feedwater and circulating

(Continued on next page)

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WHO is the master in a great power plant—man or the dynamos? This story by Mr. Adams is one of the best we have read. We believe that the majority of our readers will like the tale by this well-known writer, as it combines in a very deft way the very vital human element, together with a surpassing local atmosphere, the action taking place principally in a great electrical generating station.

pumps, stokers, draught fans, everything the turbines and boilers need to keep going—running them on direct current from motor-generators. It's all right, of course, as long as everything goes smooth. But if anything ever happens to trip out the main breakers—say a big surge or a short-circuit—every pump and fan and stoker'll stop, and so will all the turbines."

His eyes were worried. "We'd be paralyzed! It might be days before we could turn over again. I told the home office about it as soon as the designs came through and asked for a standby unit a dozen times. But they just say it's such a slim chance there's no use worrying about it."

"It is." Rodney had come taut in his chair, his mind leaping at the possibilities opened up by the chief's disclosure. Here was the thing he was looking for—the vulnerable spot of those relentless bulks. The chance Warner revealed, though, was almost impossibly remote, and there was regret in his voice. But the chief did not notice.

"Yes. It might never happen," he agreed, "and I hope it never does. But it could. It did over at Fairfax last year. They were down for a week, and we'd be in as bad a fix."

Rodney sat silent. Those roaring, arrogant juggernauts stilled, helpless—their ceaseless domination ended. He tingled at the picture. "But it's a thousand to one it would never happen," he added flatly.

Warner shook his head. "That isn't it. Think! Paralyzed! Every time a surge or short-circuit comes along I'm afraid." The fear showed in his eyes. "See if you can figure out anything we could do, Rodney. You've handled everything else so well."

"All right," Rodney agreed. But the picture of those implacable masses of steel and copper helpless and beaten dazzled him as he went down past the turbine room entrance.

Dick Brinker emerged, one shoulder bulging with a heavy brace, and Rodney halted, gazing at him incredulously. "What?" he demanded. "You back on the job?"

The little operator's washed out eyes showed surprise. "Why, I'm all right. The doctors told me I could come."

"But man!" Rodney was angry and at the same time pitying. "Wasn't once enough? Don't you know they might bump you off the next time?"

Brinker's pale face was a little blank. "Maybe, but," calmly, "I reckon not;" and he hurried on about some errand for his turbine.

Rodney frowned after him. Not even willing to escape when the chance offered—bound soul and body by the implacable domination of those roaring bulks. But that was only the more reason he, all of them, should be freed; and Rodney's pulse quickened at the thought of what Warner had disclosed.

Remote as the chance was, those inexorable juggernauts would be humbled some day, and the moment of mastery would be sweet; sweeter if he had the power to save them and withheld it. He stopped short at the ironic completeness of that. Yes. He must set his wits to evolving some plan, then, when the time came, deny them help. But meanwhile, there was nothing for him to do but submit like Dick and the rest.

At quitting time the next afternoon he was waiting in front of the main offices, pacing up and down with short, resentful strides. The air was warm with the soft breath of spring, and, yielding to its lure, six of them, including Elizabeth and himself, had planned a picnic up the river. But his face was dark with annoyance as she emerged and came toward him.

"More luck," he reported briefly. "I've got to straighten out the charging equipment in the electric truck garage. It's on a rampage. Probably work most of the night."

Her face showed disappointment. "Why, I'm sorry, Rodney."

"Leave you high and dry just because a couple of converters and a bunch of relays decide they want waiting on." His voice had a rasping edge. "It's dead wrong. I'm getting good and fed up on having to jump and run every time a turbine or transformer takes a notion it wants something."

She laid a hand on his arm comfortingly, and her voice held quiet understanding. "I know, Rodney. But don't you see how much finer it is just to let yourself be part of it—something bigger?"

His chin only tightened. "That sounds all right, but it's not, and I'm going to lick them. They won't always keep me away from you."

Tyranny that subordinated his desires, his very liberty to its demands. Quitting might be the only way out for Jerry; but the driving necessity to master those masses of steel and copper that strove to master him would not let him take that escape. He must conquer them—find a means of saving them from helplessness, then withhold it; and close to midnight, working over a maddeningly recalcitrant relay, his weapon came to hand without warning.

The trucks! The trucks! He straightened, looked down the long room, and broke into an exultant chuckle. More than a hundred stood there, ranked along the charging panels; their batteries a childishly obvious source of direct current when paralysis clutched the roaring units. His mind leaped to details: swift mobilization—simple connections—the throwing of a switch, and the implacable masses of steel and copper would be droning relentlessly once more. But that switch would never be thrown; the power of those squat, blunt-nosed vehicles would never be used.

He took a deep breath and his weary shoulders squared. Mastery was his—mastery over those inanimate bulks that sought to dominate him. He need only wait, and conquest would be worth much waiting.

"There's something in a letter from the home office that might interest you, Rodney," Warner remarked one morning late in May, passing a crisp sheet across the desk.

Since the incident of Dick Brinker, Rodney had resisted a certain quiet force about the chief that aroused respect and affection. But he was aware of a pleasant satisfaction as his eyes fell on the bracketed paragraph to which Warner pointed.

"Your reports, coupled with the report of our representative after his recent inspection," it read, "give us a favorable impression of the work being done by your Mr. Westlake; and we shall appreciate any further comments you may care to make on this young man from time to time."

Rodney looked up, trying not to seem too pleased. "Thanks, chief. That's mighty fine."

Warner's big face had lighted. "The home office doesn't pass out praise to everybody, Rodney, and neither do I. You're making good, and I happen to know they're looking for somebody to put in charge at the new Allegheny plant."

"It's good of you to tell me that, chief; but," a reserve crept into Rodney's straightforward appreciation, "there's some things I want to do here, before I'd consider going anywhere else."

Warner nodded. "That only proves I'm right." His eyes became concerned. "I hope one of them is figuring out something we can do in case of paralysis. Anything to report on that?"

Rodney shook his head. "Not yet."

He knew it was evasion only short of lying, and he hated a lie. But the power he had meant too much to be shared; and victory was too sweet to be lost. If only the surge or short-circuit Warner feared would come speedily.

But the days passed, each with the roaring masses of steel and copper exacting their toll of submission from all who served them, as if nothing could threaten their inexorable domination. Then, an afternoon early in June, Rodney's moment seemed at hand.

It had been hot in the switchboard gallery all day; not from the heat of the turbine room; a suffocating humidity the swishing fans were powerless to dispel, that grew more oppressive as the afternoon advanced. Toward three o'clock, tumbled, ominous clouds began banking up in the northwest; and by four the barometer on a panel where Rodney was checking power factor variation was falling rapidly.

"Better leave No. 3 on the line," Warner advised the chief operator, coming in from his office. "They'll be needing light when this hits; and look out for a surge or short-circuit. There's the lightning now."

The report of a tripped circuit-breaker in the switch room overhead punctuated the drone of the turbines, and the assistant operator sprang to green lights that winked simultaneously on the panels.

Gathering up his data sheets Rodney withdrew to his desk in the chief's office. These lashing summer storms always carried the possibility of tripping out the main circuit-breakers, and he was hoping for it, eagerly impatient.

A half-dozen sharp reports had followed the first, and a blast of wind brought the spattering onslaught of rain, when Jerry Markley came in. "Mind if I wait here?" he asked. "It's no use to go home. This'll probably get some transformers or cables," his eyes were wearily rebellious, "and, of course, all a man's good for around here is to take care of the precious plant."

Rodney nodded, closing windows. For a moment he was tempted to tell the tall line boss all he hoped for from this quickly advancing storm. But he said nothing. The conquest was his own, and he wanted the sweet taste of victory for himself.

They waited, Jerry with a cigarette, Rodney puffing rapidly at his pipe, while the rumble of thunder rose above the whistle of wind and the humming units; the intervals between explosive reports from overhead shortened.

"I wish somebody'd design a silencer for those breakers," Jerry exclaimed irritably after another salvo. "They get on my nerves."

But the glare of lightning was becoming less blinding, the thunder's onslaught less determined; and the roaring units were reasserting their habitual ascendancy. Rod-

(*Continued on page* 174)

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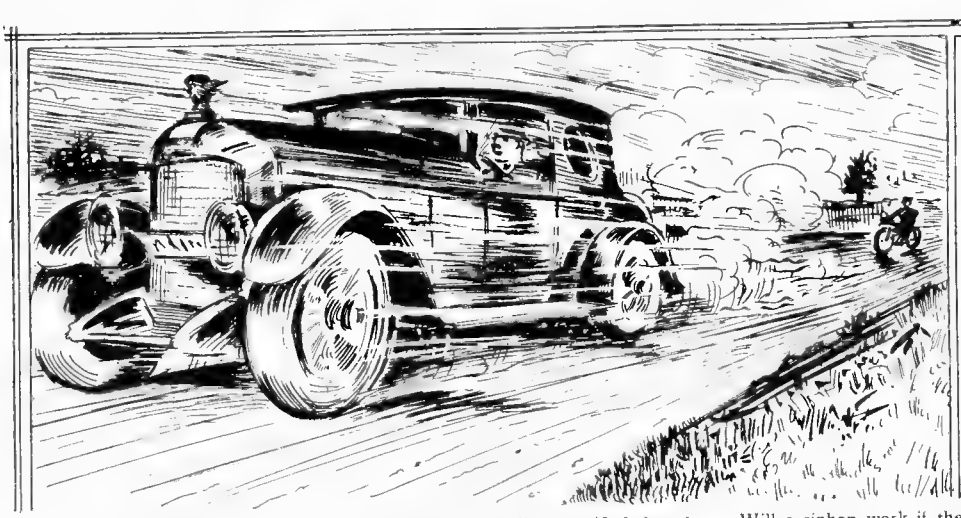
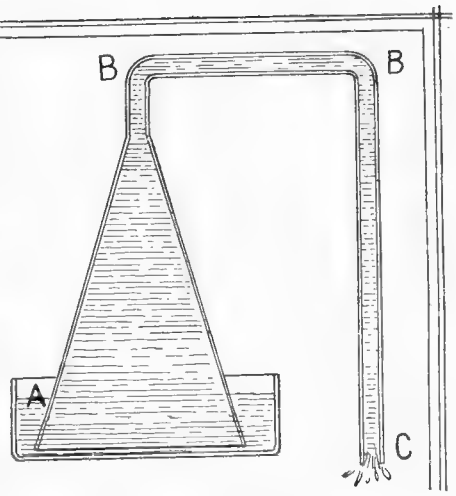
Scientific Problems and Puzzles

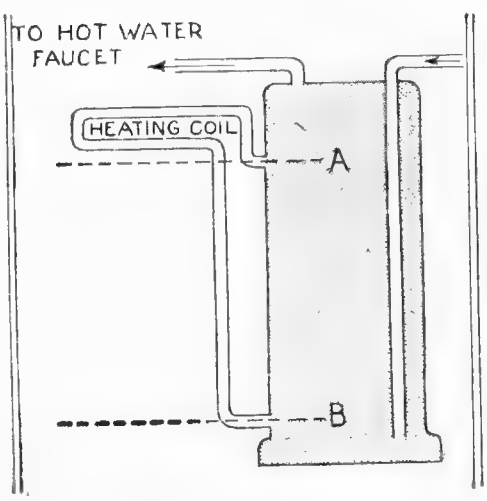
By ERNEST K. CHAPIN



When a motorist had been arrested for speeding, the officer testified that the defendant was going 60 miles an hour and that the latter had a lead of one-quarter mile when he started out in pursuit. The man was taken, however, after a chase of three-quarters of a mile. Is the officer's story credible?

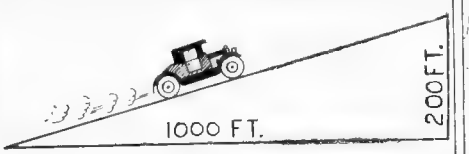


Will a siphon work if the weight of the water in the short arm AB exceeds the weight of the water in the long arm BC? The arm AB resembles an inverted funnel. The weight of the water in this arm is greater than that in the long arm which is labeled BC in the diagram. Think this over?

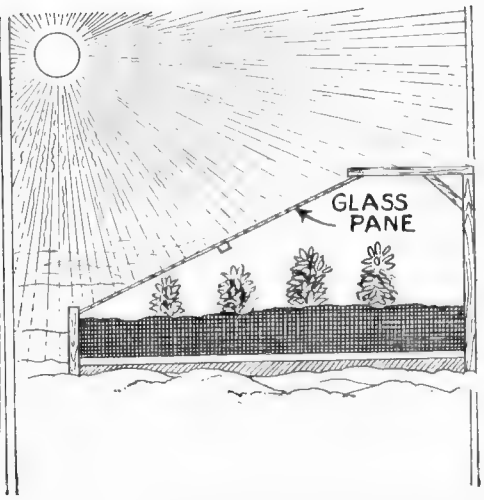


The diagram shows an arrangement for a heating coil. What is the matter, if anything, with a device of this kind? Will it really work efficiently?

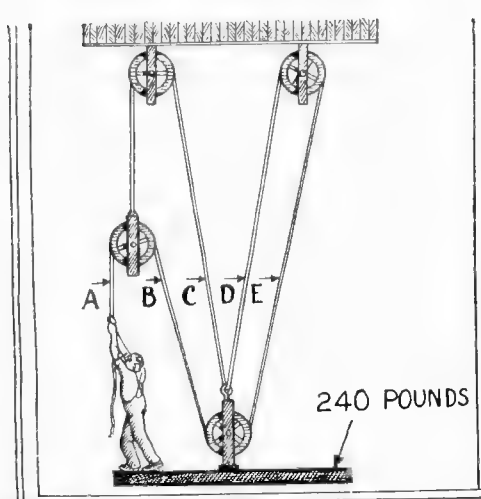
Do you know the answers to these problems presented by Mr. Chapin? If you do not, study each problem carefully before turning to the page containing the answers.
—Editor.



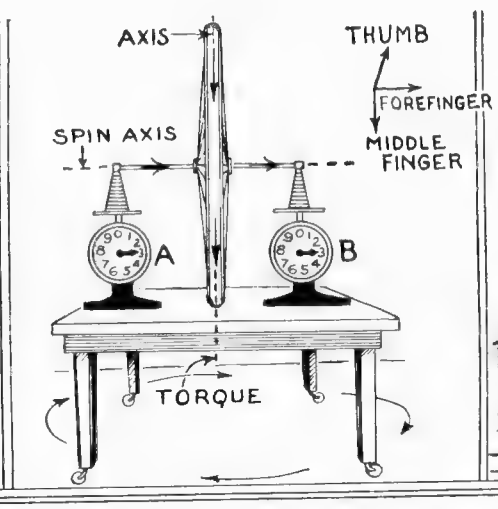
Is a road with the kind of grade as shown in the above diagram a good one? Would a car have to be in excellent condition in order to climb this hill in high gear?



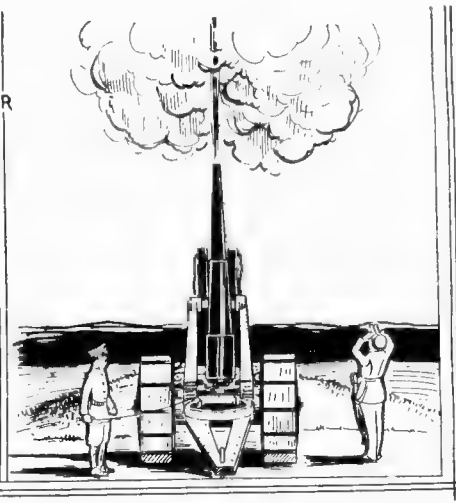
An ordinary cold frame receives no more heat from the sun than an equivalent area of ground near it. Why is the temperature inside the frame higher than that outside?



Now tackle this one. This pulley problem will prove to be a brain teaser. If the man and platform together weigh 240 pounds, what force must the man exert on the rope "A" in order to hold the platform in a stationary position? Is this at all possible?



A bicycle wheel is mounted and supported by two household scales in the manner shown in the above diagram. Suppose the wheel were set in motion in the direction indicated and the table turned around clockwise. Would the readings of the scales change and if so how?



Suppose a long range shot is fired vertically to a great altitude, upon its return to the earth would it strike east or west of the spot from which it was fired? If fired through a vacuum would this affect it in any way, or would the shell land the same as in the first case?

(*Answers to these problems appear on page* 168)

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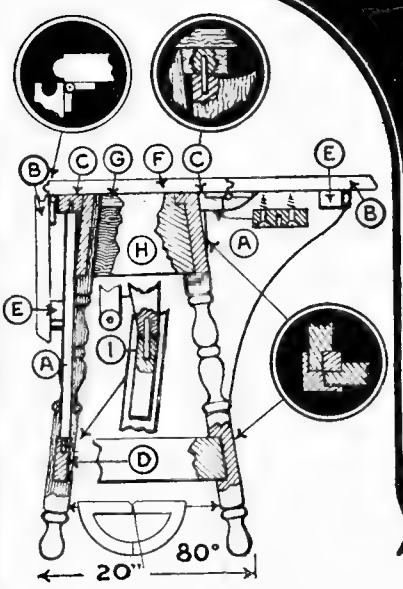
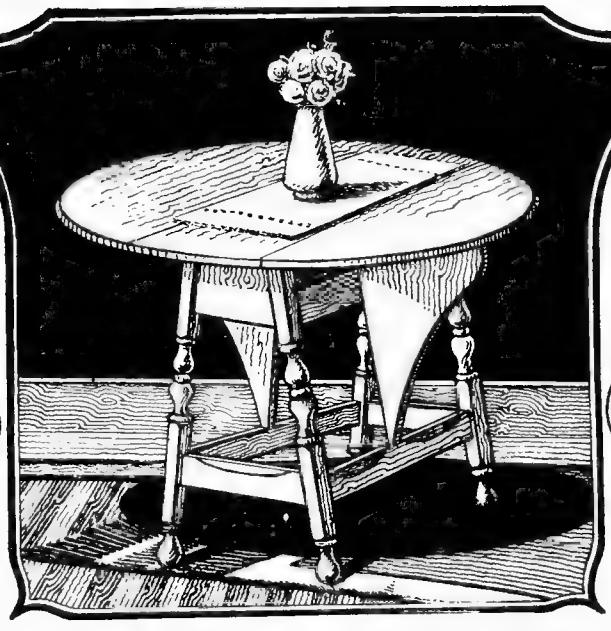
Home Mechanics

How to Make a Butterfly Table

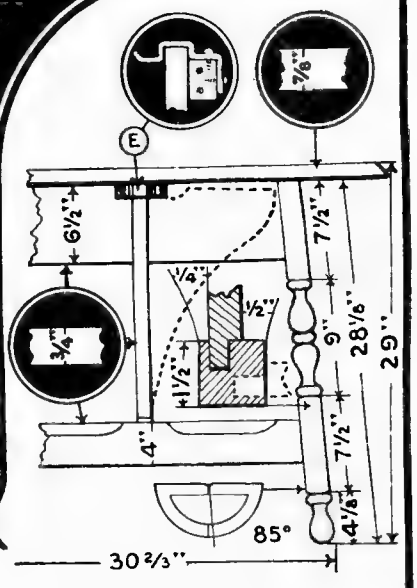
By W. M. BUTTERFIELD



Side view of the cabinet showing the letters referred to in the text.



The Butterfly Table of the Colonial period has become popular in many modern breakfast-room sets.



The constructional details of the Butterfly Table here described.

THE Butterfly Table belongs among the Colonial furniture and was probably made in Connecticut. In the early forms the top was oval, with the long part of the oval formed by the two drop leaves. Modern reproductions are both oval and round, or at times rectangular in shape. The name, which is modern, comes from the shape of the wings or braces which hold up the leaves. It has become popular, often with various modifications, as a breakfast table, and forms an item in many modern breakfast-room sets.

It is not as difficult a piece of furniture to make as it may at first appear, and if the instructions given here are followed carefully, its construction will be found more pleasant than intricate. The original tables were made of oak, maple, and walnut, but the modern reproductions are usually of pine or whitewood. The stock required is as follows:

21 feet 6 inches of ⅞" lumber 9" wide for the table top.
5 feet 8 inches of ¾" lumber 6½" wide for the frame.
6 feet 10 inches of ¾" lumber 4" wide for the spreaders.
3 feet 10 inches of 1½" lumber 10" wide for the top fastening, etc.
9 feet 6 inches of 1½×1½" lumber for the legs.
4 1½" hinges with screws ¾" long.
3 feet spring brass 1¼" wide, 3/32" thick, and 4 3/16" screws ¾" long. 18 3/16" screws 2¼" long.
1 foot ¼" steel rod.
2 moulding or pastry boards 12" wide, 20" long, and ¾" thick.

The top is formed from the 9-inch stock. Each of the three sections, which are at first 17 inches wide and 40½ inches long, are made by gluing two pieces of 9-inch lumber together, using tongue and groove joinings. Other tongue and groove joints are made where the three sections are held together with hinges—as shown in Figs. B, B. Then, before shaping the top, the three sections are placed together with temporary cleats—1½ inches wide, nailed on two sides, so as to hold the sections together like a single board. The nails are driven only where they will not interfere with the saw when the top is to be shaped. The sections thus secured are then planed, scraped, or otherwise smoothed just as a single top would be prepared. The outline, whatever its shape, is then drawn and the top shaped by sawing along the line with a keyhole or coping saw. The final finishing of its edges is done after the table is put together.

The trestle or under part of the table is formed of legs, a frame and spreaders set at angles that are 85° on the sides and 80° on the ends: in other words, the top when level is 95° measured from the end of the trestle or 100° measured from the sides. The mortises and tenons are also cut at the angles necessary for each piece as given above.

Legs: The legs are 1½ inches square and 28⅞ inches long. Each is divided into a frame post 7½ inches long, a spindle 9 inches long, a spreader-post 7½ inches long, and a foot 4⅛ inches long. Mortises for the tenons of the 6½-inch frame pieces at the top of the legs are cut ¼ inch from the outer edges of the frame posts and are ½ inch wide, 5½ inches long and ⅝ inch deep. The mortises for the 4-inch spreaders next to the feet of the legs are also cut ¼ inch from the outer edges of the posts and are ½ inch wide, 4 inches long, and ⅞ inch deep.

Frame: The frame pieces for the sides are ¾ inch thick, 6½ inches wide, and 23 inches long on the top edge (between tenons), and 24 1/16 inches long on the bottom (between tenons). The frame pieces for the ends are also ¾ inch thick, 6½ inches wide and are 9 3/16 inches long at the top edge (between tenons) and 10 29/32 inches long at the bottom edge (between tenons). The tenons for both sides and end pieces are ⅝ inch long, ½ inch thick, and 5½ inches wide, so cut as to leave a shoulder on the inner side ¼ inch wide and another on the top, one inch wide. (See detail drawings.)

Spreaders: Each of the four 4-inch spreaders is ¾ inch thick and four inches wide. The side spreader pieces are 25 11/16 inches long on the top edge (between tenons), and 29 9/16 inches long on the bottom edge (between tenons). The end spreader pieces are 14⅜ inches long at the top edge (between tenons), and 15½ inches long (between tenons). The tenons are cut so as to leave a shoulder on the inner side ¼ inch wide and are ⅝ inch long, ½ inch thick and 4 inches wide (see detail). Both the side and end pieces are chamfered as shown. Holes for the pins holding the braces are bored at an angle of 80°.

Braces: Wings or braces are made from the moulding board and are ¾ inch thick, 11 inches wide and 18⅞ inches long. They are made so that one cleat will run across the top of each brace and are nailed together in their original form, so as not to interfere with the saw, then both are sawed at the same time, following the shape shown in illustrations. A ¼-inch steel piece, two inches long, is used at both ends of each brace to hold them in place and to form a pivot for them to turn on (see Figs. I and C). The backs of the braces are rounded and the pins set in the center of the semicircles thus formed. A ¾-inch iron washer ⅛ inch thick is used between the end of each brace and the spreader.

Brace Block: The top pins of the braces are held by wooden blocks 1½

(Continued on page 181)

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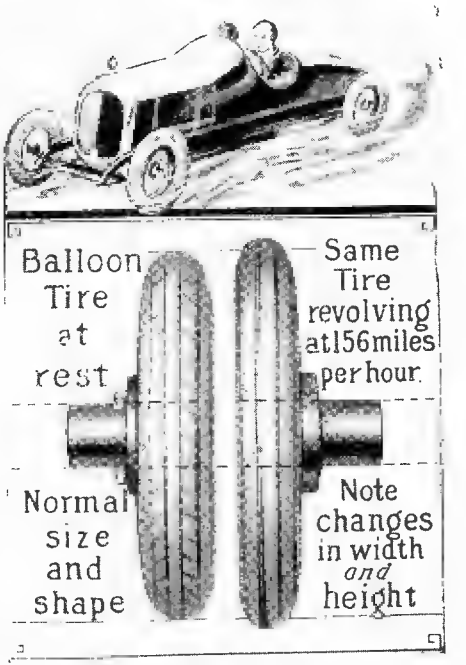
Camera Size Arc Light

Three views of the new arc light are shown above. The outfit, which only weighs 6 pounds, can be used for taking indoor motion pictures and indoor still views. In fact, any "shot" that requires an artificial light may be taken by using this new device. The "Cameralite," as it is called, is sufficiently compact to be contained in such a small space as $3\frac{1}{4}$" x 6" x 11".

THE new photo lamp shown, a blue-white twin arc light of compact construction has recently been developed. In appearance it is just about the size of a large Kodak with the same general form. It operates either from A.C. or D.C. at 1,000 watts and draws about 10 amperes. The commendable feature of the outfit is that though it is no larger than the average camera, all its accompanying accessories such as a 15-foot lampcord, table stand, handle and carbons are nicely tucked away in the case itself. It can be set up and lighted in the short time of two minutes and can be knocked down in a like period of time. It can be used in conjunction with daylight where large areas are to be photographed or in outside work where a flash is inconvenient or undesired. It is well known that a flashlight cannot be used for motion pictures and even in the case of stills where a flash can be used the arc light is much more preferred. Obviously, the average home is no place for the cumbersome commercial arc, heretofore the only one of its type obtainable. The new arc light can be moved about readily, as it can be held in the hand and, if desired, it can be mounted on the special tripod which is supplied with it. So simple is it in operation that a blow on the carbons is all that is necessary to extinguish them. Its real field is found among those who have become amateur motion picture enthusiasts. The safety with which it can be operated by the novice is a factor not to be overlooked.—*Hy Bayer.*

Balloon Tires

A BALLOON tire at rest, of course, retains its natural size and shape, as shown in the illustration below. The same tire when revolving at a speed of 156 miles per hour changes in width and height; the changes are proportional to the speed. These changes in the tire are due to centrifugal force, which causes the tire to become narrower and higher.



Shape taken by tires at rest and at high speed.

The Astrology Humbug

By JOSEPH H. KRAUS

Further Letters From Our Readers and Our Answers

ASTROLOGY TESTED 12 YEARS

Editor, SCIENCE AND INVENTION:

The two articles, "The Astrology Humbug" and "The Truth About Astrology," in your October, 1926, number show either crass ignorance of the subject, or, a desire to mislead your readers.

I shall first ask you to give me the sex, initials, place, year, day of month and time of day, within four minutes of the time of the first cry, of the three subjects. State if daylight-saving time or the correct time is given, also if the subjects are human beings (*information sent—subjects are human beings.*—EDITOR.)

As doctors do not try to diagnose without a thorough knowledge of heredity and environment, so also astrologers require this information in giving a correct reading, but your hostility to astrology will no doubt prevent you giving this data. I am not asking for the above data with the idea of winning your prize, as your requirements of "location" and "detail" of the major events, and "accurate, detailed and perfect horoscopes" prevent any such possibility. If the same terms were required of a doctor in his diagnosis and treatment of a case, or, of a surgeon in an operation, and whether the patient would live or die therefrom, no medical man would escape your censure, and you would have to come to the conclusion that the practice of medicine and surgery was unscientific and a humbug. I admit there are quacks in astrology as in medicine and other sciences and that a great deal of religious, mystical and theosophical twaddle has attached itself to astrology; but, my twelve years daily testing of astrology has cured me of my original skepticism and compelled me to recognize astrology as my only unfailing guide through life, after unsuccessfully trying religion and spiritualism.

Huxley, in his "Science and Hebrew Tradition," says, "Astrology is a science insofar as it *professes* (*italics ours*—EDITOR) to reason logically from principles established by just inductive methods." True astrologers follow the scientific method of observation, and sifting and correlation of observations, the formulation of an hypothesis, and the reference of this hypothesis to all the facts, i. e., it covers all the facts without contradictions and omissions. These observations have extended over centuries. Astrology welcomed the discoveries of Uranus and Neptune, as they explained certain unforeseen conditions and events. Astrology follows with appreciation the scientific discoveries in astro-physics and electro-magnetism as helping to locate the vital force at the back of everything. Astrology like every other science does not claim to have absolute knowledge, but is daily seeking data and evolving like other sciences. Astrologers are trying to find the source of planetary, lunar, and stellar influences. Science admits that Neptune was discovered by the eccentricities in the orbit of Uranus. Science says that the Sun, with the Moon, causes the tides. Science says the sun-spots, which seem to coincide with the eleven-year cycle of Jupiter, cause atmospheric and electrical storms on our earth. Science has not yet been able to measure accurately the rate of our Moon's motion which astrologer's claim is affected, like our earth, by the other planets. Science says that sunlight is necessary to life on this earth. Science says that the atom has a centre or nucleus of positive electricity, corresponding to our Sun, and around it revolve the electrons of negative electricity, corresponding to the planets. It has also been observed that the movement of the planet Mercury is similar to that of the potassium atom, and that electrons follow Kepler's laws relating to astronomy. Science resolves the universe into electrons, protons, together with their electro-magnetic fields, and space-time. We thus have the atoms of matter, which contain the elements of life and energy, reflecting our solar system, which astrologers claim affects individual characteristics and events, as well as causing storms, earthquakes, and the other phenomena of life. As the Stoics said, man is a microcosm reflecting the solar system above him. How it is done, astrology cannot yet say, but observations show that certain phenomena occur with certain solar, lunar, planetary, and stellar positions.

The old argument about twins dates back to Cicero's "Divinatio," and is revived by Augustine with the difference between Jacob and Esau. However, Augustine is only interested in replacing so-called astrological fatalism by the theories of predestination and divine foreknowledge, which are more stringently deterministic, as he states that the seasons vary with the sun, and that sea-urchins, oysters, and the tides are increased or diminished by the waxing and waning of the moon. The difference between twins was explained in ancient times by the principle of the Prenatal Epoch. There is a reference to it in Plutarch's "Romulus," Ptolemy's "Tetrabiblos," Sir C. Heydon's "The Trutine of Hermes," and fully discussed in E. H. Bailey's "The Prenatal Epoch," 1916.

(*Continued on page 166*)

$6,000.00
For Proofs of Astrology

SCIENCE AND INVENTION Magazine holds that there is nothing scientific in Astrology, that Astrology is not a science and that statements made by astrologers unless very general cannot be entertained seriously.

Accordingly, this publication has decided to award an Astrology Prize of $6,000 for the following:

$5,000 will be paid to the astrologer or forecaster who will foretell three major events of such a nature that he will have no control over the outcome of the same. He must describe in advance each event in detail, giving the location and result or the casualties if the event is an accident.

$1,000 will be paid to the astrologer or forecaster who will produce three accurate, detailed and perfect horoscopes, free of contradictions on the lives of three people whose initials will be given him when he requests the same and the birth dates and place of birth will also be supplied by this office.

This contest closes October 1st, 1927, and all entries must reach us by that time. In event of a tie, prizes of an identical nature will be given those so tying.

Address all entries to Editor, Astrology, care of SCIENCE AND INVENTION Magazine, 230 Fifth Avenue, New York, N. Y.

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Our Spiritualistic Investigations

NO. 11 OF A SERIES

By Dunninger.

THE fact is generally accepted that some of our cleverest mediums, are women. Notwithstanding this statement, and although men are quite in the minority, in this instance, at least, the writer has found at least two or three male wonder workers, who might be fairly heralded as master minds, in their chosen art of deception. The medium, whose method of operation I am herewith describing, was, for some years back, known as Professor Omar. At this period, he was what is commonly called a carnival fortune teller, traveling with a moving show, and thus covered quite an area of territory, playing the smaller towns throughout the eastern states. This sort of circus education has been the makings of many great showmen, who up to this date, rank foremost in various branches of the theatrical profession. Having had a thorough schooling, and being gifted with fluent language, Omar likewise profited by this traveling form of education, and being exceptionally brilliant and observant, not alone availed himself of all the education his tour afforded, but likewise became quite a student of human nature . . . a general exponent of psychology, so to speak. This brief outline of the man's former training was recently described to me by one who knew him. I happened to explain my experience, which I am about to herewith describe to my readers, to a group of friends, one of whom recognized the name of my subject, who, during the time of my investigation, was known as Professor Alexander Kima.

Ushered into his studio one day, by a hunchback attendant, I was asked to take a seat, and was given quite a reasonable wait, which perhaps was done to give me ample time to prepare myself for the fee charged by the medium, which the attendant took pains to explain, would be $25.00.

The attendant departed, and in a few moments the door re-opened. Enter, Prof. Kima. With a brilliant smile, and an extended hand, the Prof. welcomed me to his web. With a quick glance, and the shrewdness which had come with years of experience, I plainly felt that I impressed him rather unfavorably. He seemed skeptical, and in a most polite manner, put me through a flowery third degree, which examination I apparently passed, as he soon ushered me into his studio. This room, of fair size, contained several pieces of furniture, a few chairs of non-corresponding type, a victrola, a radio set, a bookcase, and more letters of endorsement, affixed to the walls. The professor took great pains to explain that he was a genuine medium, and quite different from all others, whom he referred to as fakers. He explained that usually messages were produced by confederates, and emphasized the fact that he would at no time leave the room or permit his servants to enter.

The professor then brought forth six slates, which he placed on a table directly in front of me. "Examine these," he said, "and you will find them unprepared, I am sure. At some future date, if you choose, bring your own slates, and I will use them instead, if you so desire," he added. Accustomed as I am to handling trickster's paraphernalia, a very brief examination was sufficient to satisfy me that the slates were quite intact. I was requested to choose two, which I readily did, and after writing my initials upon them at the professor's request, they were for a moment, laid aside, but in full view upon the top of the victrola. The wizard now asked me to mention the name of

(*Continued on page* 177)

$21,000.00 for Spirits

Dunninger, who writes exclusively for SCIENCE AND INVENTION Magazine and who is the Chairman of our PSYCHICAL INVESTIGATION Committee will personally pay $10,000.00 to any medium or spiritualist who can present any psychical manifestation in so-called spiritualism, that he will not explain or that he cannot reproduce by natural means.

More than two years ago SCIENCE AND INVENTION Magazine offered a prize of $11,000.00 to anyone who could demonstrate his or her ability to communicate with the spirits or to give some definite form of a psychical demonstration which in itself was not trickery.

The result has been that mediums and spiritual organizations have been afraid to place proofs before us. Those weak attempts which have been made to demonstrate psychical phenomena were almost instantly proven fraudulent, and no medium has dared to contradict our findings.

In view of these facts, should we not consider all mediums fraudulent?

To the $10,000.00 which has been offered by Joseph F. Rinn through this publication for Spiritual proofs and the $1,000.00 in addition offered by SCIENCE AND INVENTION Magazine we now add Dunninger's $10,000.00.

So now we have a total of $21,000.00 offered for proofs of Psychical Manifestations. Spiritualists—get busy.

"I was requested to choose two of the slates. They were for a moment laid aside, but in full view on top of the victrola."

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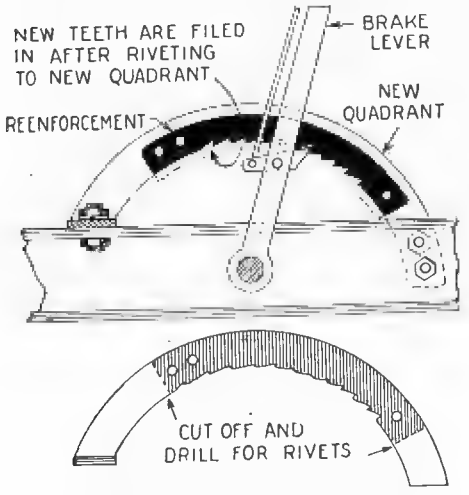
MOTOR HINTS

Conducted by GEORGE A. LUERS

DO YOU KNOW—spark plugs wear out. The porcelains may get porous from cracks, absorb carbon, current is led away from points and engine is erratic.

REENFORCING THE BREAK LEVER PAWL QUADRANT

The wear on the pawl quadrant, which secures the brake lever of the car, is usually heavy, mainly because it is not tempered


NEW TEETH ARE FILED IN AFTER RIVETING TO NEW QUADRANT
BRAKE LEVER
NEW QUADRANT
REENFORCEMENT
CUT OFF AND DRILL FOR RIVETS

ALTERATIONS FOR THE OLD QUADRANT CONVERTING IT TO NEW USE

The above illustration shows how to repair the brake-lever quadrant on your car.

and the pawl is usually hardened. Drivers adopt many makeshifts, when the quadrant is stripped and only recently one driver had rigged on his car a short length of chain and a hook to hold the brake, when the car was parked.

On the car where the brake pawl quadrant wears rapidly, the reenforcing means shown in the sketch will prove worth adopting, at the time of renewing the quadrant.

As shown, this is a new quadrant, to the side of which is riveted the toothed section of the old quadrant. After attaching, the new teeth are cut into the old section, with a saw file.

This provides a full width quadrant, which has double the usual wear and practically doubles the period of service and time between renewals.

Ford drivers, particularly will appreciate the advantage of this reenforcement.

SOCKET HANDLE SIMPLIFIES SPARK PLUG REMOVAL

A handle for the spark plug socket wrench, can be added, employing either of the methods shown in the attached sketch. The first type shown is an end piece of an old tie rod from the steering gear, in which the yoke end spans the socket wrench and is held in place with a pin or loose rivet.

The second type shown, is made from a piece of strap iron, bent and drilled for a loose pin, attaching this to the socket.

The advantages of this form of tool for spark plug removal are several. The tight plug is loosened readily and is turned out quickly, with a rotating motion. The single tool takes care of the removal of the plug, as no extra wrench or handle is required.

HEADLIGHTS WILL SUPPLY AMPLE LIGHT FOR REPAIRS

The writer is frequently asked the simplest way to provide working light for night use around the car.

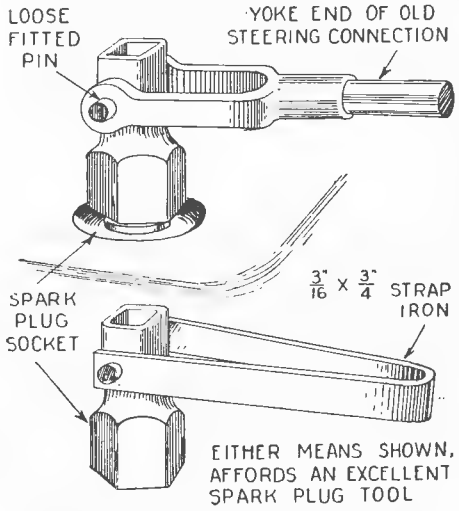
The average driver finds it is sometimes necessary to accomplish night repair work, both in the garage and on the road. Where the garage is provided with a lighting system, the use of an extension light solves the problem. Less than fifty percent of the garages are so equipped, for which reason the information given below will solve the owner's needs.

The sketch shows a means for providing light for all purposes, direct from the headlights of the car.

To handle the headlights, it is advisable to replace the usual nuts, with knurled and tapped sleeves, through which a hole is drilled. Any pointed tool, will loosen the lamp.

The lamp can then be either turned in the socket or removed and placed in any place convenient to support it temporarily.

The jack board, which is the wooden block used as a jack footing in soft ground, can be used as a support, by boring a socket in this, into which the end of the lamp bracket or tongue is placed.


LOOSE FITTED PIN
YOKE END OF OLD STEERING CONNECTION
3/16" X 3/4" STRAP IRON
SPARK PLUG SOCKET
EITHER MEANS SHOWN, AFFORDS AN EXCELLENT SPARK PLUG TOOL

It is much easier to remove spark plugs when the handle shown above is attached to the wrench.

The block can then be placed on the running board on the floor or ground.

A simple extension cord for the lamp socket, provides for the removal of the lamp from its original location.

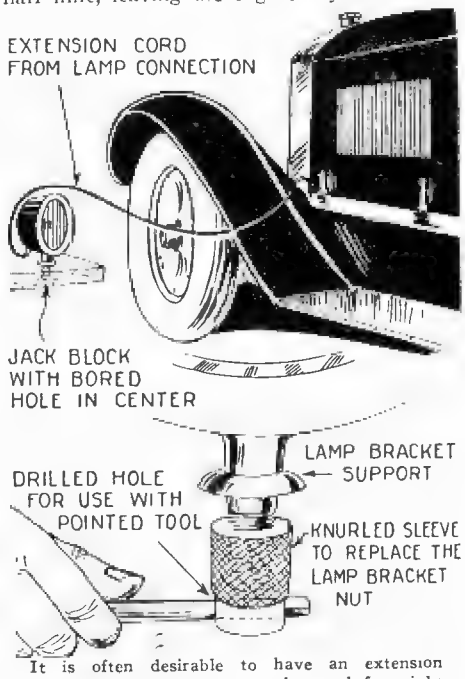
Lamp brackets differ, but practically any of them can be made detachable and used for purposes of illumination.

A RADIATOR HOSE REPAIR AND GOOD USE OF A MAT

Repairing the car when in trouble is not so much a detail of hard work, as it is of knowledge what to do when things go wrong. If trouble comes at a distance from a service station, the motorist must look upon his own resources for the needed repairs.

An example of how to meet a trying situation, is shown in the attached sketch. This means was used during the last touring season, by one experienced motorist.

The lower radiator hose of the car, split abruptly, emptied the water in less than a half mile, leaving the engine dry and hot.

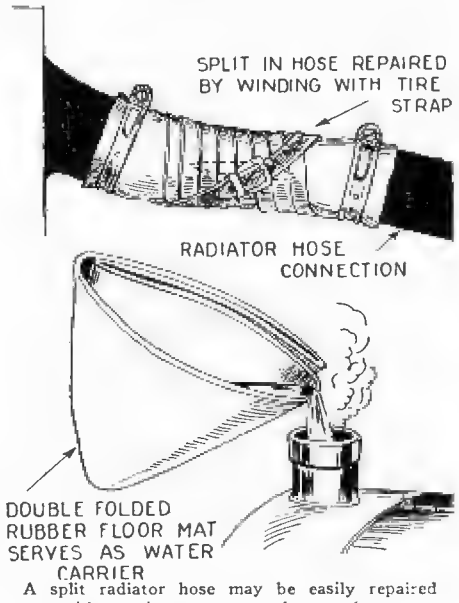

EXTENSION CORD FROM LAMP CONNECTION
JACK BLOCK WITH BORED HOLE IN CENTER
LAMP BRACKET SUPPORT
DRILLED HOLE FOR USE WITH POINTED TOOL
KNURLED SLEEVE TO REPLACE THE LAMP BRACKET NUT

It is often desirable to have an extension light in the garage or on the road for night work.

A small tire strap was used to bind the broken hose, which it did tightly and solidly. The car was a distance from water, and the rubber floor mat was converted into a water carrier, by folding it double as shown.

The delay was only of short duration, and the repair was good for many miles of uninterrupted driving.

These are expedients, serving to illustrate the advantage of being alert to possibilities. How many of us know what to do when the rim wrench is lost, the jack is missing, vacuum tank runs dry or the oil pump fails? The observant motorist knows, because he is alert to learn from other people's experience.


SPLIT IN HOSE REPAIRED BY WINDING WITH TIRE STRAP
RADIATOR HOSE CONNECTION
DOUBLE FOLDED RUBBER FLOOR MAT SERVES AS WATER CARRIER

A split radiator hose may be easily repaired with a tire strap as shown above.

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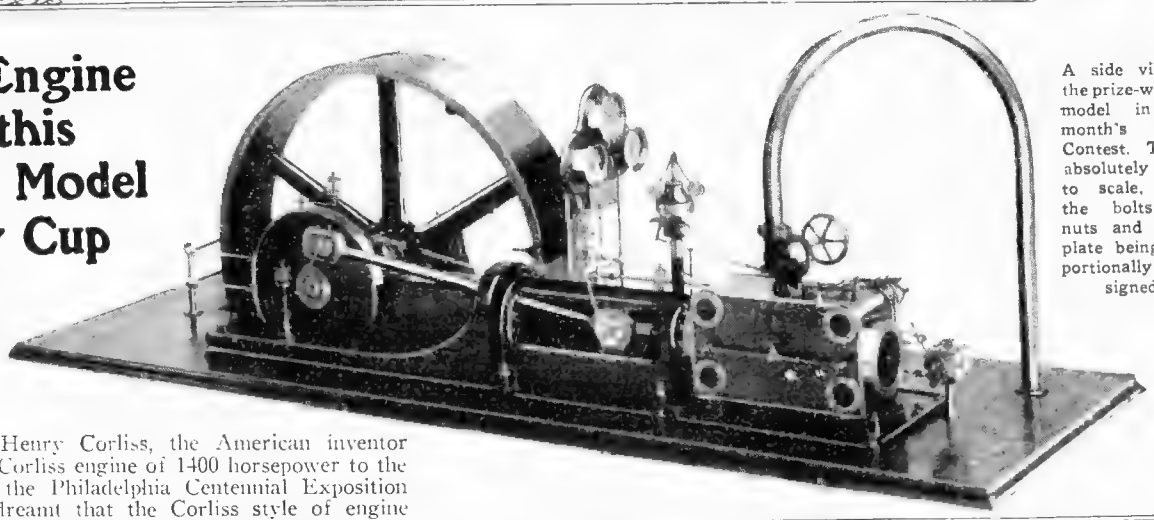
MODEL DEPARTMENT

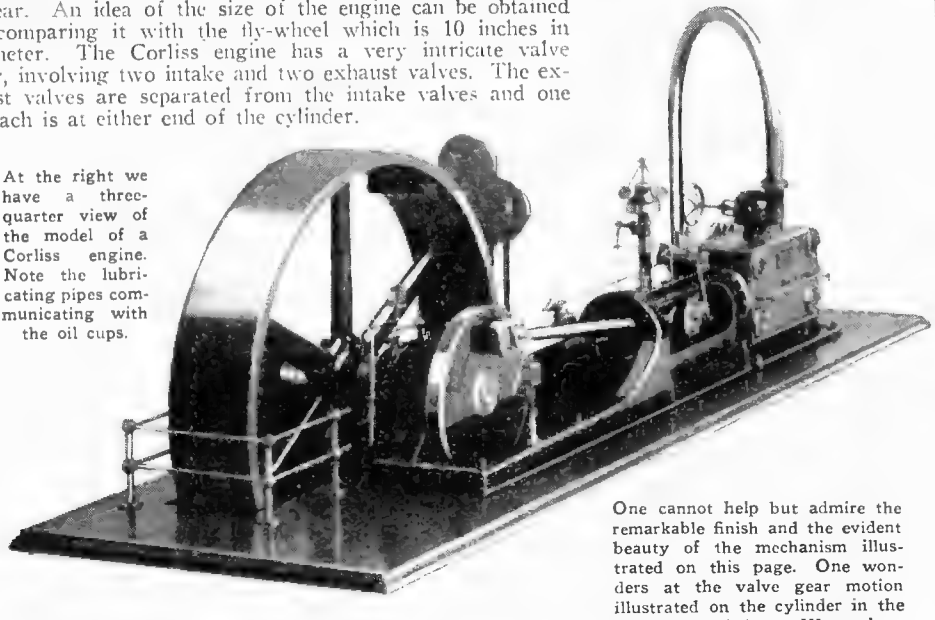
Corliss Engine Wins this Month's Model Trophy Cup



A side view of the prize-winning model in this month's Model Contest. This is absolutely true to scale, even the bolts and nuts and nameplate being proportionally designed.

WHEN George Henry Corliss, the American inventor furnished the Corliss engine of 1400 horsepower to the Machinery Hall in the Philadelphia Centennial Exposition in 1876, he never dreamt that the Corliss style of engine with its many modern improvements would be made the subject of a model. On this page three photographs of a model Corliss engine as built by Mr. Fred Knapp of Racine, Wis., appear. An idea of the size of the engine can be obtained by comparing it with the fly-wheel which is 10 inches in diameter. The Corliss engine has a very intricate valve gear, involving two intake and two exhaust valves. The exhaust valves are separated from the intake valves and one of each is at either end of the cylinder.

At the right we have a three-quarter view of the model of a Corliss engine. Note the lubricating pipes communicating with the oil cups.

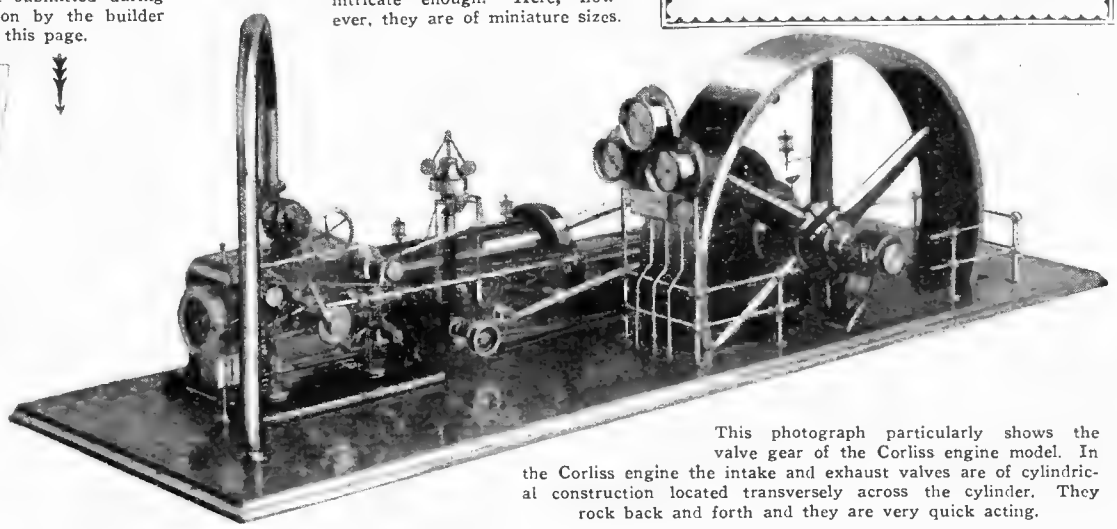


One cannot help but admire the remarkable finish and the evident beauty of the mechanism illustrated on this page. One wonders at the valve gear motion illustrated on the cylinder in the photograph below. Were these parts made full size, it would be intricate enough. Here, however, they are of miniature sizes.

Rules for Model Contest

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based upon, A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.
2. Models of all kinds may be entered They may be working models or not, according to the subject that is being handled.
3. Models may be made of any available material, preferably something that is cheap and easily obtainable. Models made of matches should not be submitted to this department but should go to our Matchcraft Contest Editor.
4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.
5. Models should be securely crated and protected against damage in shipment and sent to us by parcel post, express or freight, prepaid. Models will be returned when requested.
6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the July contest must reach us on or before the 25th of April.
7. Address all entries to Editor Model Department, c/o Science and Invention Magazine. 230 Fifth Ave., New York City.

Below is the trophy cup which is monthly awarded by this publication for the best model submitted during the month. This month it was won by the builder of the engine illustrated on this page.



This photograph particularly shows the valve gear of the Corliss engine model. In the Corliss engine the intake and exhaust valves are of cylindrical construction located transversely across the cylinder. They rock back and forth and they are very quick acting.

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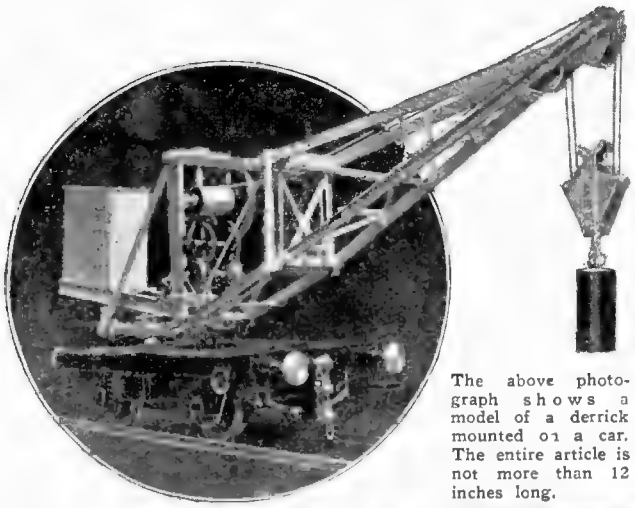
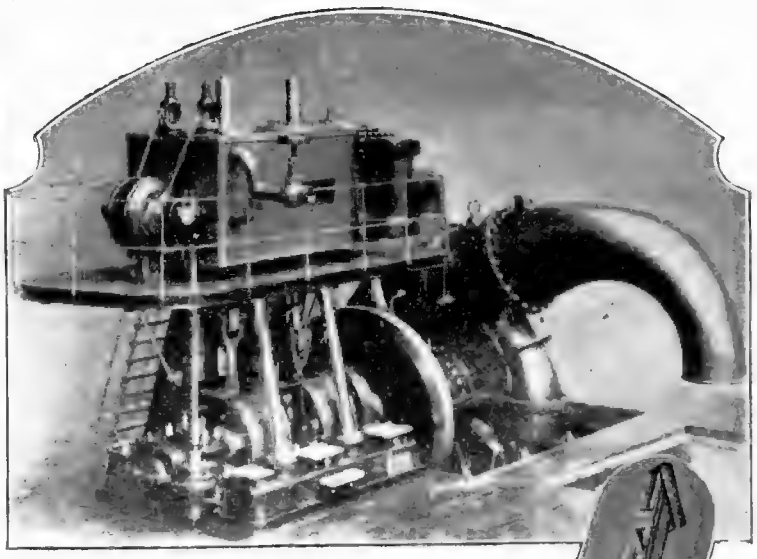
German Model Industry

One Organization In Germany Devoted Entirely To The Construction Of Models. Inventors, Engineers, Brokers And Instructors Find Models Of Inestimable Value.

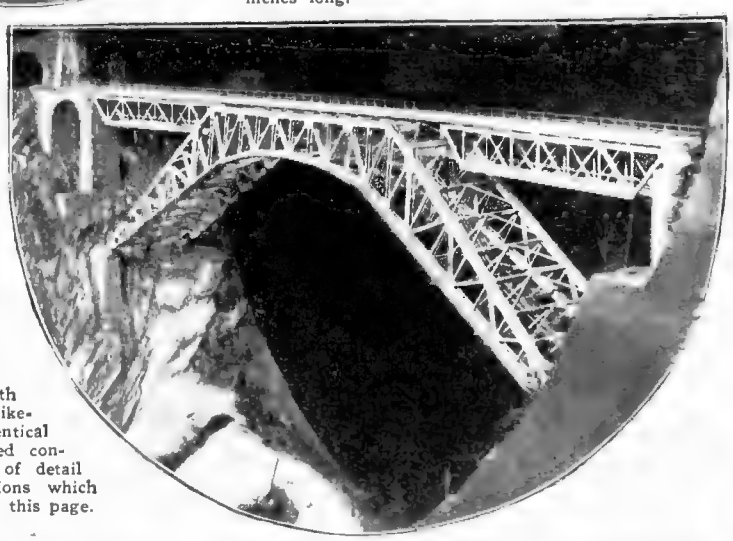


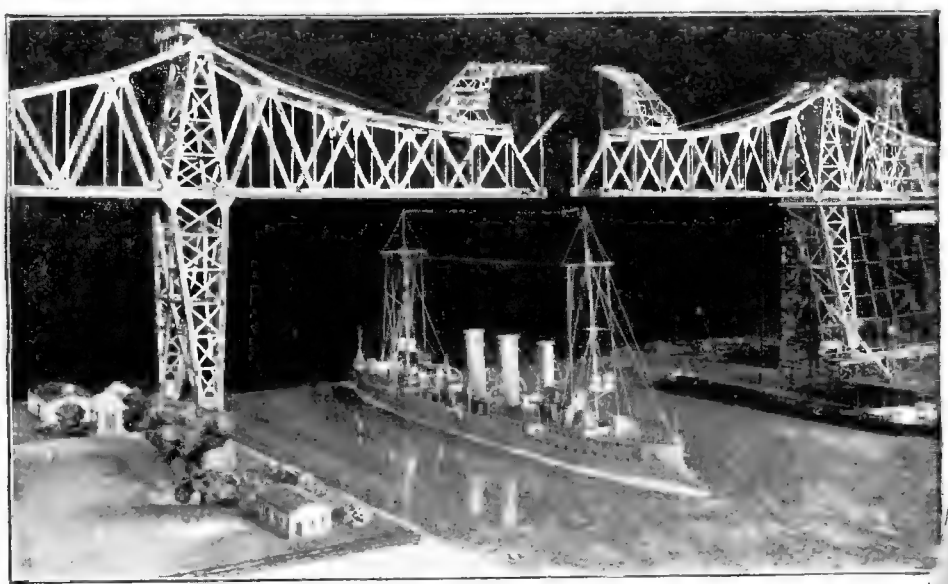
The above photograph shows a model of a derrick mounted on a car. The entire article is not more than 12 inches long.



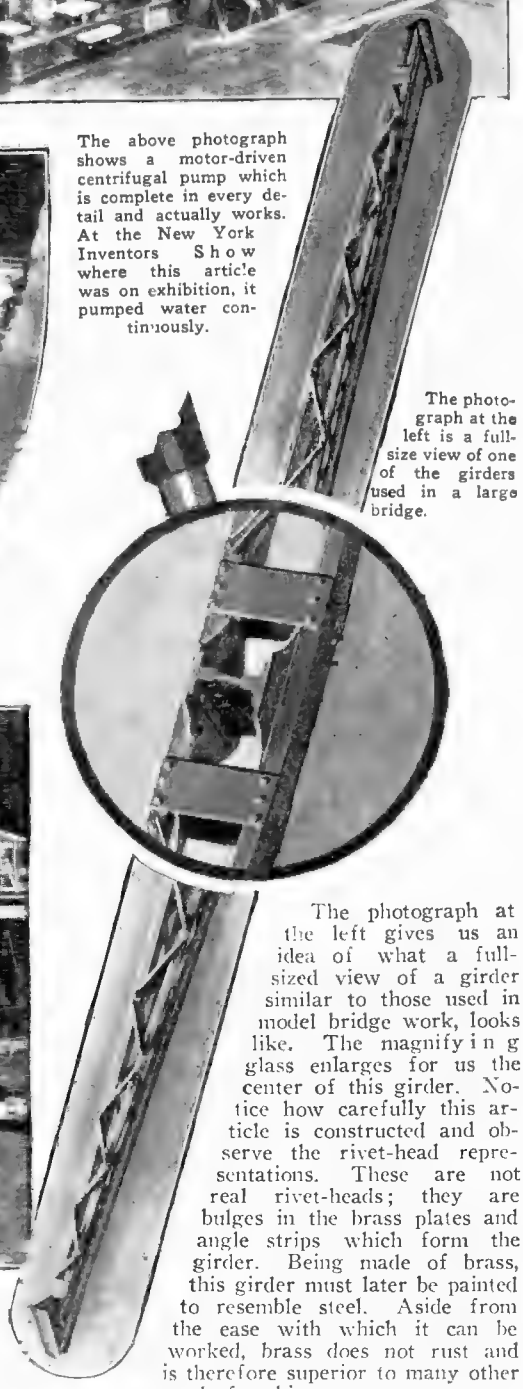
The above photograph shows a motor-driven centrifugal pump which is complete in every detail and actually works. At the New York Inventors Show where this article was on exhibition, it pumped water continuously.

The photo at the right shows a model bridge as made by the organization experts dealing entirely with the construction of miniature models. It will be observed that the bridge as well as its foundations are complete in every detail. Each individual girder is formed and seemingly riveted together before being used in the bridge assembly. A cement roadway is found and concrete anchorages at both ends of the bridge are likewise made in a manner identical with those in the finished construction. For accuracy of detail there are few constructions which can equal those shown on this page.





This view shows a bridge in the process of construction. Two cranes are mounted, one on each half of the stand, and the work is apparently proceeding from both sides at the same time. Closer observation will reveal how the girders are riveted together near the left approach and the left-hand tower. The vessel in the foreground is mounted on rippled glass, painted in such a way as to represent water. The reflection in the water is obtained from the glass.—E. A. Giessen, representing Fabrik fur Feinmechanik.



The photograph at the left is a full-size view of one of the girders used in a large bridge.

The photograph at the left gives us an idea of what a full-sized view of a girder similar to those used in model bridge work, looks like. The magnifying glass enlarges for us the center of this girder. Notice how carefully this article is constructed and observe the rivet-head representations. These are not real rivet-heads; they are bulges in the brass plates and angle strips which form the girder. Being made of brass, this girder must later be painted to resemble steel. Aside from the ease with which it can be worked, brass does not rust and is therefore superior to many other metals for this purpose.

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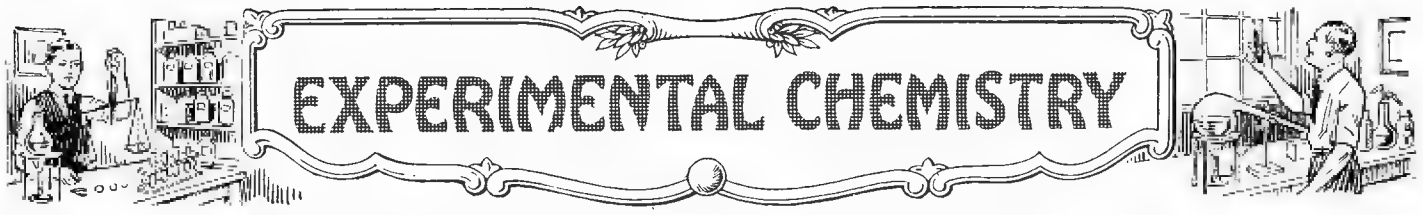
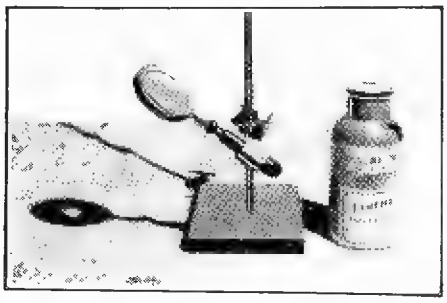


Experiments with Some Chemical Chameleons

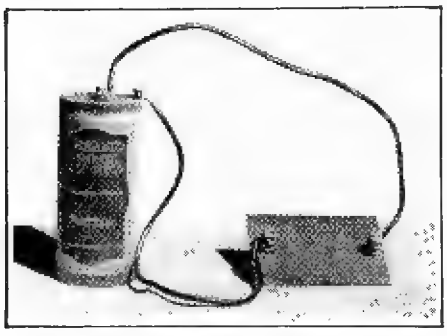
By RAYMOND B. WAILES

THE compounds of mercury and iodine with their color changing properties have always attracted the attention of the younger experimenters in chemistry, for their chameleonistic changes when acted upon by heat are very amusing.



Focusing the suns rays upon a bit of red mercury iodide will cause it to turn yellow. This salt has been proposed as a coating for the ends of shafts and bearings to show if they are running hot.

The red and yellow compounds of mercury with copper, silver and iodine are the ones which are extremely sensitive to heat. The red iodide of mercury can be bought and used as is, but the more complex the experimenter will have to make himself. To make the yellow silver-mercuric iodide dissolve about four grams of potassium iodide in 35cc of water and two grams of mercuric chloride in another 35cc of water. Mix the two solutions and a precipitate will form which should be brought back into solution by adding more potassium iodide. If a precipitate does not form proceed as follows: To the solution of the precipitate which formed add a solution of two grams of silver nitrate in 25cc of water. A yellow precipitate of silver-mercuric iodide will form. Allow this to settle. Pour off the colorless liquid above. Add fresh water. Allow to settle and again pour off the colorless liquid. In this manner the by-product salts can be repeatedly washed out. Finally, allow the precipitate to dry in the air when it can be scraped from the beaker and preserved. It will turn to a red color at about 50 degrees C. (122° F). It can be mixed with gum Arabic solution and painted on cards, or wherever desired.

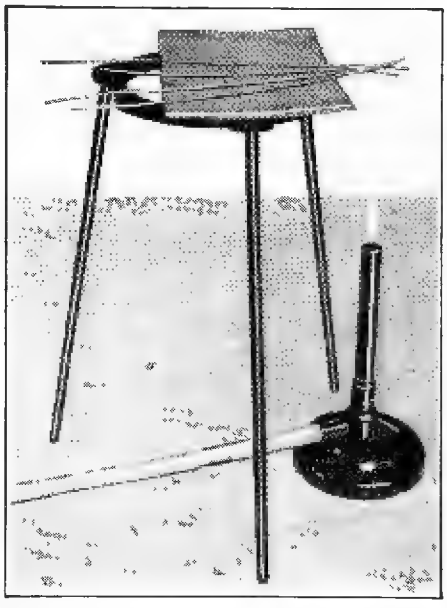


Heating effect of an electric current can be shown by this little set up. A thin wire is supported just above a piece of cardboard coated with mercury iodide. A current of electricity heats the wire and changes the color of the mercury salt.

Mercuric iodide can be made by gently heating a drop or so of metallic mercury in a test tube with a crystal of iodine. A chemical reaction will ensue, with the formation of red mercuric iodide which will sublime upon the walls of the test tube. It can be removed and used in the experiments.

The rays of the sun if focused upon a speck of either of the two iodides will cause them to change color. A lighted cigar placed in back of a sheet of paper upon which is coated one of the two iodides will also change its color at the spot where the heat is applied.

The substances can also be used to show the heating effects of a fine wire when a current of electricity is passed through it. For this experiment, take a card coated with say, the yellow iodide, and mount two binding posts on the card. Stretch a piece of number 30 copper or other wire between the posts so that the wire is about a sixteenth

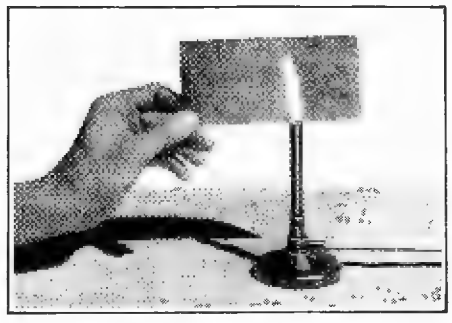


Thermal conductivities of different metals can be demonstrated using a card coated with iodide of mercury. Wires of different metals are heated at the end; those of highest conductivity produce color stripes on the mercury salt for the greatest length.

of an inch from the card. On connecting a battery with the wire through the binding posts, the sensitive iodide will change its color due to resistivity of the wire. Christmas tree tinsel makes a good resistance for this experiment.

The thermal conductivity of different metals can also be shown by using lengths of wires of different metals. Iron, copper, German silver, aluminum, nickel, etc., can all be used. They should be laid upon the coated card so that one set of ends of the wires all come to one point and they then spread and assume the shape of a fan. By applying heat from a burner to the ends of the wires in the center of the segment thus formed, the wires will become heated and will conduct heat differently as evidenced by the difference in color formations beneath the wires.

The color change is only a physical and not a chemical one. To show the latter, hold a sheet of polished copper vertically in the flame of a Bunsen burner. A picture of the flame will be imprinted upon the copper sheet due to the different colors of the different oxides of copper produced, or their



A polished sheet of copper exhibits flame pictures when held in a blue flame. This is used to show how color may be a chemical phenomenon.

film thicknesses. Here is an example of a color change caused by a chemical reaction.

One of the most curious experiments which can be performed with a mercury iodide is to cause a stone to float upon a solution of it in potassium iodide. To prepare a little bottle of floating stones, one should make a solution of potassium iodide in water and then add red iodide of mercury to the solution until no more will go into solution. Now add more of red iodide of mercury and then some solid potassium iodide which will in turn dissolve the excess mercury iodide, if too much has not been added. The object is to put as much red mercuric iodide into as strong a potassium iodide solution as

A strong solution of mercury iodide in potassium iodide will float pebbles of quartz, pearl buttons and similar substances. The diamond sinks in it; it is used as a test for this precious stone.

possible. Never add water to make the iodides go into solution. Soon the solution will have such a high density that small stones can be floated upon the surface. A number of stones of many shapes and sizes should be secured and washed. Many of them will sink but no trouble should be had

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in finding several which will float. The writer floated a stone about an inch long and half an inch wide by a quarter of an inch thick upon such a solution, which is still bobbing around merrily when the stoppered bottle containing it is shaken. This solution has been used to identify diamonds, as they are of so high a specific gravity that they sink in it, while quartz pebbles float.

EXPLOSIVE SOAP BUBBLES

By LLOYD M. WEBER

Nearly every experimenter desires some excitement in his laboratory once in a while. The explosive soap bubble is a means of affording excitement by noise rather than spec-

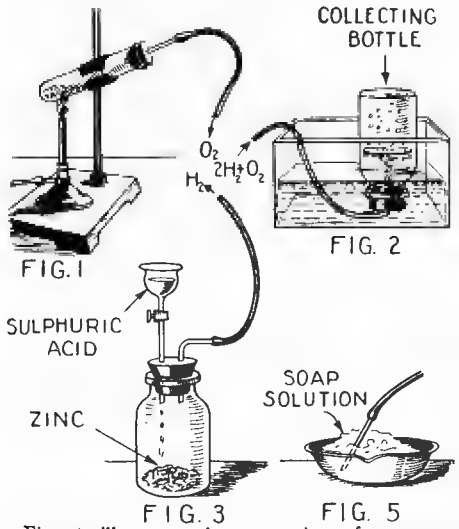


Fig. 1 illustrates the generation of oxygen from potassium chlorate and manganese binoxide. Fig. 3 is a hydrogen generating apparatus. If a crystal of copper sulphate is dropped into the bottle, the hydrogen would generate better. Fig. 2 shows the collecting of gases and soap bubbles are blown with the mixture of approximately 2 volumes of hydrogen and 1 of oxygen and a lighted match makes them explode violently.

tacular excitement. The secret underlying the whole matter is the fact that when the two gases, hydrogen and oxygen, are mixed in approximately exact proportions the mixture is very explosive. When a bubble, containing a mixture of the gases mentioned is ignited an explosion occurs. The bubble may be ignited with an electric spark or a match. When the gases unite water is formed. Now, since a liquid is less in volume than its gas the volume contracts, causing the air to rush in. A loud report is heard when the explosion occurs. The intensity of the noise is dependent on the size of the bubble.

The first step in this experiment is to generate a small amount of oxygen. To do this mix on a piece of paper about 5 grams of potassium chlorate and 2 grams of manganese dioxide. Place this mixture in a hard glass test tube, provided with a one-hole rubber stopper and a delivery tube. (Fig. 1.) Connect this delivery tube to the collecting bottle (Fig. 2). The collecting bottle is filled with water which is replaced by the gas. Heat the test-tube gently until the collecting bottle is one-third filled with gas. Disconnect the apparatus, leaving the apparatus, containing the gas undisturbed.

Before proceeding any further extinguish all open flame lamps. Do this to prevent any accidental explosion that might occur had this been left undone.

To generate the hydrogen place a small amount of zinc in a flask provided with a two-hole stopper, a delivery tube and a thistle tube (Fig. 3). Connect this apparatus to the bottle already containing oxygen. Gently pour a small amount of sulphuric acid into the thistle tube, a few drops at a time, until the bottle (Fig. 2) has been filled. The zinc coming in contact with the hydrogen in the sulphuric acid replaces it and liberates hydrogen gas.

After the bottle has been filled with the gases provide it with a two-hole rubber stopper, a delivery tube, and a stop-cock thistle tube (Fig. 4). Make certain that no gas escapes by filling the thistle tube with water.

Next, prepare a soap solution (Fig. 5) in a saucer and fill a bubble with the mixture of gases. This can be done by putting the nozzle of the delivery tube below the surface of the soap solution, and forcing the gas out by allowing the water in the thistle tube to enter (Fig. 5). After a bubble of desired size is produced remove it from the apparatus and ignite it. The result will be a loud report, and the formation of water.

TESTS FOR THE HALIDES

By M. M. EISENSTADT

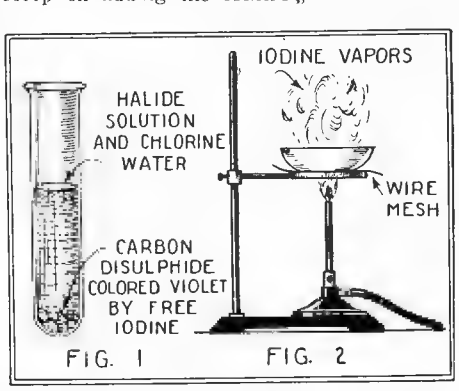
Since the three halides, chlorides, iodides, and bromides, all give more or less whitish precipitates, when silver nitrate ($AgNO_3$) and nitric acid are added to their solutions, it is extremely difficult to distinguish these precipitates from each other, in an unknown.

A very efficient set of tests for these three halides is as follows:

To a portion of the unknown in a test tube, add a few drops of carbon dissulphide (CS_2), and then a few drops of some freshly prepared chlorine water. Shake the contents of the tube thoroughly, and let stand for a moment or so. If the carbon dissulphide is colored purple then the presence of an iodide in the solution is indicated. If the CS_2 is colored a reddish brown then a Bromide is present, and there is no iodide in the solution, since the purple color of the iodide will always hide the color of a bromide.

Let us assume that there is an iodide in the solution and that the CS_2 is colored purple. Then pour out the clear solution above the CS_2 into another test tube, to it add some more carbon disulphide and shake thoroughly. Continue doing this until the CS_2 is colorless, or reddish brown. If it is reddish brown then a bromide is also present in the solution.

Put the rest of the unknown in an evaporating dish, and to it add a sufficient amount of ferric sulphate $Fe_2(SO_4)_3$, and sulphuric acid (H_2SO_4) and then boil. If there is an iodide in the solution, violet iodine vapors will be liberated. Continue boiling until no more vapors are given off. Then to the solution add a few drops of potassium permanganate ($KMnO_4$), and heat again. Keep on adding the $KMnO_4$, until it is no



Test for iodine. In a certain sense it is the most impressive of the halides. Its violet color is very beautiful when it is dissolved or is in gaseous form.

longer decolorized. The adding of the $KMnO_4$ is only necessary when a bromide has been found to be present.

Allow the contents of the dish to cool, and then filter the solution if necessary. Test it for a chloride, by adding $AgNO_3$ and HNO_3 to it. A white curdy precipitate indicates a chloride.

The three equations for the three silver halide ppts. are:

$$NaCl + AgNO_3 \rightarrow \underset{\text{White}}{AgCl} + NaNO_3$$

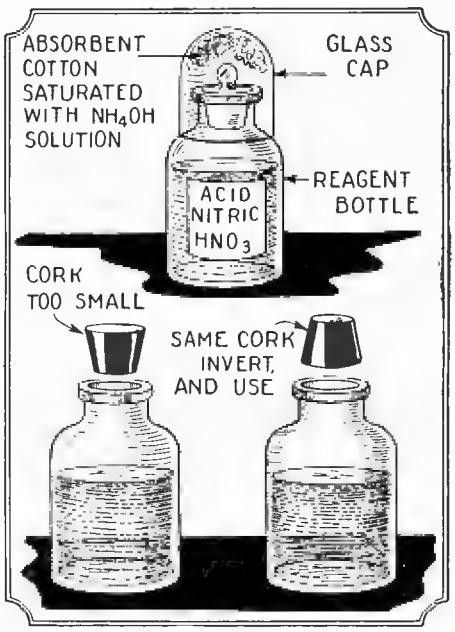
$$NaI + AgNO_3 \rightarrow \underset{\text{Pale Yel. White}}{AgI} + NaNO_3$$

$$NaBr + AgNO_3 \rightarrow \underset{\text{Pale Yel. White}}{AgBr} + NaNO_3$$

Utmost care should be taken that all reagents and chemicals used are fresh and C.P.

NEUTRALIZING ACID FUMES

A very fine method of neutralizing acid fumes given off from reagent bottles containing such strong and volatile acids as hydro-



A glass cap made from a test tube is used to color the neck of an acid bottle. Cotton saturated with an alkali is stuffed into it. Below it is shown how to make a small cork fit a large bottle.

chloric and nitric acids, is shown in the above sketch.

A plug of absorbent cotton is placed in the bottom of a glass bottle cap—such as is used to protect necks of bottles from dust, etc., and this is saturated with a strong alkali solution—such as sodium hydroxide solution.

CORK BOTTLE KINK

Chemical experimenters are not usually overstocked with corks and rubber stoppers. Sometimes it happens that a cork of a certain size is needed—and cannot be found. By the above method a cork which is too small and sinks too deep into the neck of the bottle and cannot be easily removed with the fingers, will often fit if it is simply inverted and used as shown.—Contributed by *F. R. Moore*, Reporter No. 1993.

WATER AND HEAT

Put a little freshly burnt lime in a test tube. In a second put in the following mixture: Equal parts of ammonium chloride and of potassium nitrate. Mix well by shaking or in a mortar. The salts should be powdered. Hold one of the tubes, the one with lime in the left hand; the other in the right. Request someone to pour a little water in each. The tube in the left hand will give off steam and become so hot that it cannot be held, while the one in the right hand becomes so uncomfortably cold that it, too, cannot be held with comfort.

Contributed by Julius Mersand.

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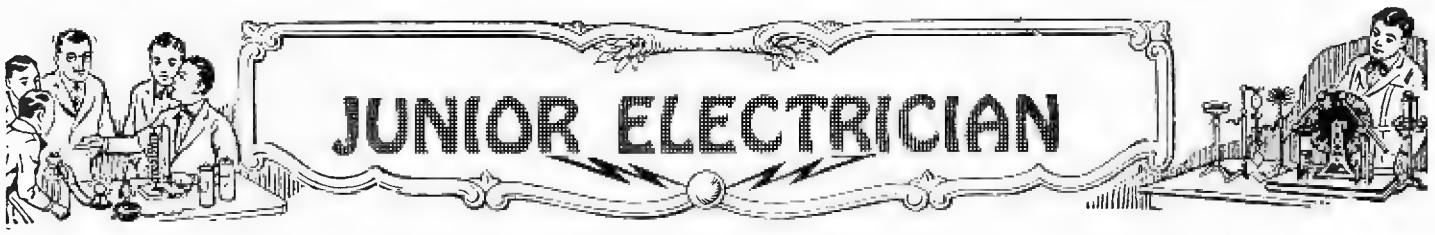
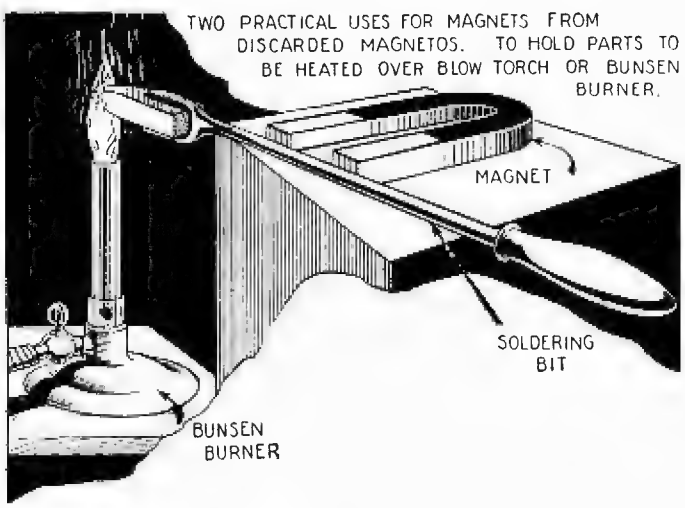
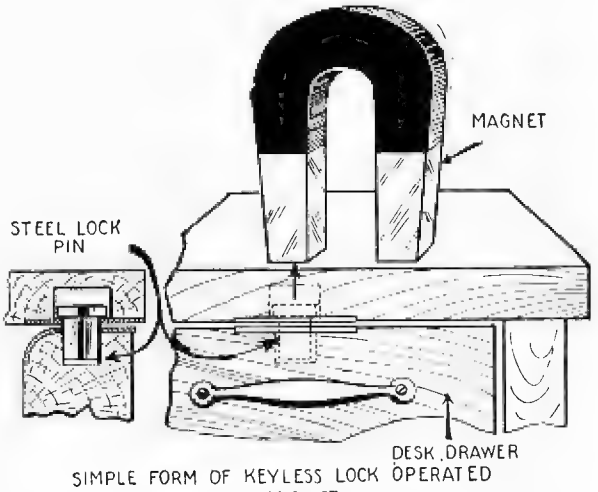


Two Practical Uses for Magnets from Discarded Magnetos

By G. A. LUERS


TWO PRACTICAL USES FOR MAGNETS FROM DISCARDED MAGNETOS. TO HOLD PARTS TO BE HEATED OVER BLOW TORCH OR BUNSEN BURNER.
MAGNET
SOLDERING BIT
BUNSEN BURNER

Left: A powerful permanent magnet is used to hold a soldering iron in the flame. It can also be used in heating a joint to be sweated with solder. Right: A magnet is used to draw a bolt so that the drawer can be opened. The concealment is perfect and the drawer may be safely locked if no one knows the secret.



SIMPLE FORM OF KEYLESS LOCK OPERATED BY MAGNET.

IN the attached sketches two practical uses for old magneto magnets are shown which uses have an everyday value for the shop man or around the average home.

The first use shown which involves an ordinary magnet, is that of supporting a soldering bit or material to be hardened over the Bunsen burner or blow torch.

The advantage of this is that it allows of a wide variation in position, avoids clamps and the parts will not roll away from the magnet.

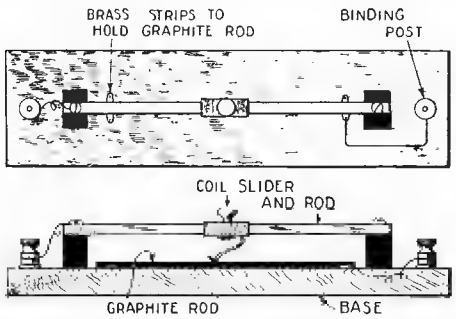
In the second pictured detail, a means for the handling of a locking bolt with a magnet, which is applicable to doors, drawers or other locked compartments is shown. Instead of a lock, an ordinary steel rod, free to slide back and forth, serves as a bolt, and the magnet serves as the key. This makes a concealed form of lock, simple to apply, but especially desirable, for small drawers in the personal desk, tool drawers and instrument lockers. It will be found that this works quite well when a strong magneto magnet is available.

LEAD PENCIL RHEOSTAT SUITABLE FOR MANY PURPOSES

By H. J. HANNIFAN

A RHEOSTAT is shown here that can be easily and quickly constructed of scraps usually found around the workshop or laboratory. The base of this rheostat is a block of wood and the slider is taken from an old radio tuning coil that has seen its best days. The graphite strip can be taken from a lead pencil. When this rheostat is assembled it can be used to regulate the current from a battery of dry cells to run a small motor or a miniature bulb.

The slide has as contact piece a flat brass spring, as this gives a more secure contact than that afforded by a piece of wire. The operation is so obvious that further description is not needed.



The lead from a pencil and a sliding contact in connection with it give a very efficient and convenient rheostat.

EMERGENCY BRUSH REPAIR

Recently one of my generator brushes gave out, and after limping several miles to a garage, I found there was no help, as the proprietor had no brushes! And the next garage was 38 miles away, 6,500 feet down in the valley!

The trouble was remedied, however, with the aid of a hack-saw, drill, and old battery. The dry-cell was broken open and the carbon removed. This carbon is about one inch across and six inches long. A section was cut out somewhat larger than the old brush and filed down to the exact size. The two holes were then drilled in with a hand drill, and the correct angle filed on the commutator end of the brush. Great care must be used in drilling the holes, using very little pressure, as the carbon is so brittle that it cracks very readily. It is well to drill the holes before sawing out the pieces. This is only a temporary job, however, and the proper brush should be put in as soon as possible. The carbon in the dry cells contains no copper, and is of much higher resistance than the copper-impregnated brushes made for auto generators. The result is that the emergency brush will heat quickly, and clog up the commutator with burnt carbon. However, it is well worth the trouble of making when you are stranded!

Contributed by Ralph A. Lambert.

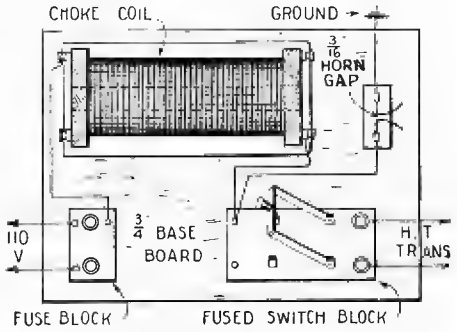
KICKBACK PREVENTER FOR HIGH TENSION TRANSFORMER

By ANTHONY J. CHRISTOPHER

KICKBACK PREVENTER

The Underwriters' rules call for a protective device in all cases where a step-up transformer is attached to the lighting circuit. An easily made kickback preventer is described herewith. It consists of a fused switch block, choke coil, horn gap and separate fuse block.

The horn gap is made from a porcelain base taken off a knife switch. Upon it are mounted two pieces of 3/16" round brass rod, bent horn shape. The air gap should be 3/16". A seven inch piece of 2" diameter tubing may be used for the choke coil. The ends are turned up from pine wood. Four layers of 100 turns each, of number 16 or 18 gauge s.c.c. wire are wound on this spool, each layer terminating at a binding post. This choke coil not only chokes the high tension current which may kick back into the power line but also



If a step-up transformer is attached to an A.C. lighting circuit, the insurance authorities sometimes require a kick-back preventer. Above is shown one embodying a horn gap on the ground line, and a choke coil. A fuse is required on the switch block.

serves to limit the input to the transformer, which may be regulated by varying the number of layers in the circuit.

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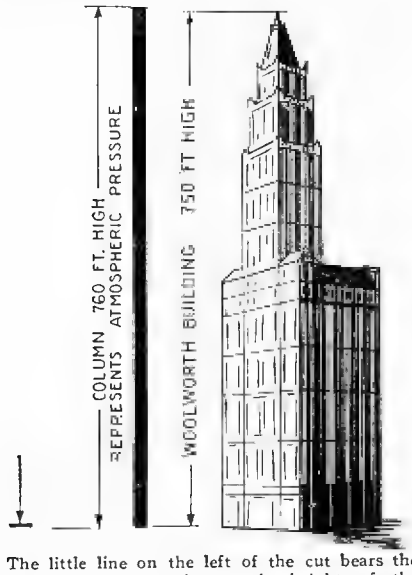
What Is the Pressure Inside a Radio Tube

By E. V. SIMDT

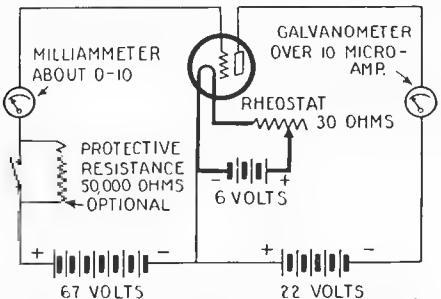
IF atmospheric pressure (14.7 lbs. per sq. inch) be represented by a gigantic column 760 feet high—10 feet higher than the Woolworth Building—the pressure in the average hard radio tube would be represented by the thickness of a cigarette paper. That of a soft detector tube would be about an inch high.



The little line on the left of the cut bears the approximate proportion to the height of the Woolworth Building that the air in a soft tube as used in radio bears to full atmospheric pressure. It is supposed to be only an inch high, but of course had to be drawn thicker in order to show.

Measurement of high vacua: In scientific work low pressures are usually expressed in terms of millimeters of mercury. Atmospheric pressure is equal to 760. mm. In other words a pressure of 14.7 lbs. per sq. in. will just support a column of mercury 760 mm. high.

The pressure in the average hard radio tube is usually about .0001 mm. of mercury.



Distribution of apparatus for measuring the vacuum in a radio amplifying tube. By this system great accuracy of result is attained.

In soft detector tubes it varies between .01 and .1 mm.

There are many very interesting and ingenious ways of measuring such high vacua. The ionization method, described here, is the easiest and most popular among tube manufacturers.

The hook-up for this method is shown in the accompanying schematic drawing. Turn on the filament current slowly until three milliamperes is flowing in the grid circuit. Each microampere (millionth of an ampere) read in the galvanometer will then indicate approximately .0002 mm. pressure.

How it works: This is what happens: The electrons, flying from the filament with a velocity of several thousand miles per second to the positively charged grid, collide with the residual molecules of air and knock off one or more of its electrons. This destroys the electrical equilibrium of the molecule and it becomes a positive ion, which is attracted to the negative plate. As the filament is positive with respect to the plate, part of the negative ions are attracted to it. A difference in potential is thus established between the filament and plate, causing a current to flow through the galvanometer. As the pressure or number of molecules is increased the number of collisions is correspondingly increased with a subsequent larger flow of current.

It might seem that at such very low pressures there would hardly be any air molecules left to collide with. This however, is not the case. At .0001 mm. of mercury one cubic centimeter (1/16 of a cubic inch) still contains about 3×10^{12} or 10 with 12 ciphers following—molecules. An equal number of oranges three inches in diameter and set side by side, would reach around the earth about 5675 times and form a belt of oranges at the equator over 1400 feet wide. Or if placed in a straight line they would reach from the earth to the sun and over 40,000,000 miles beyond it.

It is important, when reading the pressure of the tube, to keep the grid current, or number of electrons passing from the filament to the grid, at the specified value (3 milliamperes) in order that each microampere of plate current will represent the above stated pressure. The calibration given is for a standard 201-A tube with the flat type plate and grid.

The calibration is accomplished by having a tube and a MacLeod vacuum gauge, or other measuring device already calibrated in terms of mm. of mercury, connected to the same vacuum line while evacuating it. Simultaneous readings are then taken on the tube and gauge and the galvanometer in the plate circuit may thus be calibrated to read directly in terms of pressure if desired. A different geometrical arrangement of the plate, grid and filament, or a change in the electrical values used, will give the plate current a different pressure value.

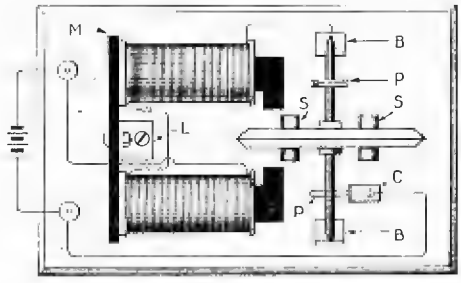
A Simple Electric Motor

By EARL ALDRIDGE

A SIMPLE electric motor, which makes an interesting toy for the young electrician, is described here. Its essential features are the use of a gyroscope wheel or of a metallic top for the fly-wheel. These are sold in the various toy stores. Referring to the illustration, the wheel just alluded to is designated by the letter G and is mounted in the bearings, B. Two soft iron pins, S, are clamped in the spokes, diametrically opposite each other. A short piece of stout copper wire, P, is placed in the eye in the axle for the string. The copper spring, C, is placed so that a contact is made with P twice in each revolution. An electro-magnet, M, is supported by L so that the pins, S, pass directly between its poles.

If the wheel is not in such a position that P and C are in contact when the circuit through the battery is made, the wheel can be started with the hand. When contact is made one of the pins, S, will be near the magnet poles and will be magnetized inductively. It will therefore be attracted and the wheel will turn. The pins, S, should be so placed in the wheel that when one of them comes directly between the poles of the magnet the circuit is broken. If this were not so the magnet would tend to stop the wheel and then start it revolving in the opposite direction. After the contact of P and C is broken the wheel will continue to revolve owing to its great moment of inertia. Contact is made with the opposite end of P and the process is repeated. This kind of motor, after it has attained a considerable speed, operates very steadily.

The construction is open to various modifications. It might be interesting to increase the number of armatures, S, and make the commutator arrangement, P, correspond to the increased number. The interesting feature is the use of a well-balanced fly-wheel, because from the nature of things, if a top or a gyroscope wheel is used these will be found to be well balanced.

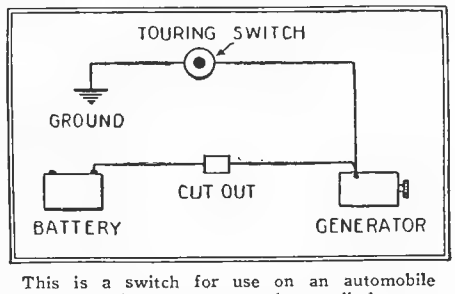


A very nice construction of a simple electric motor using a wheel from a toy gyroscope for the fly-wheel. Armatures are mounted on it and a simple commutator system is mounted on the shaft.

TOURING SWITCH FOR CAR

On long motor trips when touring there is often great waste of energy caused by continued overcharging of the battery, the battery is fully charged by the long run and the continued charging simply boils away the distilled water and overheats the plates, it also uses a good deal of the engine's power.

Many owners turn their headlights on to overcome this trouble, but this is at the best a makeshift as the generator still uses power and the life of the bulbs is being shortened; what is wanted is a means to cut out the generator when it is not needed to charge the battery.



This is a switch for use on an automobile which enables one to take almost all the generater load off the engine when the battery is sufficiently charged. The great point to be observed is to connect the wire from the generator on the proper side of the cut-out.

This can be easily accomplished as follows: Obtain an ordinary single-pole lighting switch and mount on the dash, now run a wire from one pole of the switch to the generator binding post and a wire from the other pole of the switch to ground; now with the switch closed the generator is short-circuited and as is well known under such conditions a shunt-wound generator does not generate power and the only load the generator places on the engine is just enough to overcome the friction. When the battery needs charging the switch is opened when the generator will at once start to charge. The only point to watch in wiring up this device is to be sure and get the generator wire on the generator side of the cut-out. *Contributed by Guy E. Mcallan.*

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THE CONSTRUCTOR

Making Rustic Bottles

By HERBERT C. McKAY

From time to time one sees curious bottles made from the limbs of trees or they may be clever imitations. The preparation of these bottles is so simple that with a few trials and a little perseverance anyone can duplicate them.

The completed rustic bottle is shown in the photograph at the left.

Gesso is spread over the surface of the bottle with a flat bit of wood. The wooden base and cork may be seen.

The putty-like material, with which the bottle is covered is called a gesso and may be prepared by mixing whiting, liquid glue, a small amount of linseed oil and a few teaspoonfuls of clear varnish. The bottle is set aside to dry and one or two small limbs are fastened to its outer surface. These are also covered with the gesso.

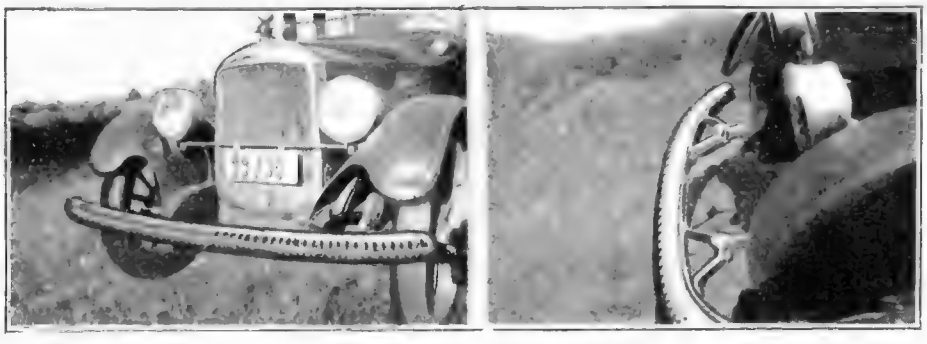
The bark texture is made before the gesso is dried, by running a sharpened stick over it to produce the irregular surface. This is being done in the photograph at the lower left. Do not try to closely imitate some particular natural bark; if the major grain runs lengthwise this will be sufficient, as natural bark textures vary a great deal.

When the gesso has thoroughly dried over the whole surface, paint is applied. Oil colors are used. A dark olive-gray is used for the ground coat, touched up with olive green. A study of natural color will help in this matter. Again no exact color scheme has to be followed, as the color in nature is of a great variety.

Pneumatic Bumper

By Dr. E. T. SONENDRIKER

An old second hand clincher rim of the Ford type is used. The rim is fastened to the car by two metal loops. Next an old tire of the clincher type is cut to the proper length. The ends are afterwards plugged with two pieces of wood. An old innertube is also cut to size and fitted into place. The valve stem should coincide directly with the valve outlet on the rim.



The open ends of the inner tube should be vulcanized so that it can be inflated to about 20 or 25 pounds pressure. The bumper can be painted any color desired, preferably, to match the color of the car. This style of bumper will be found to give excellent service and the outstanding feature is the fact that it may be reinflated whenever it goes "flat." Bumpers of this type are inexpensive.

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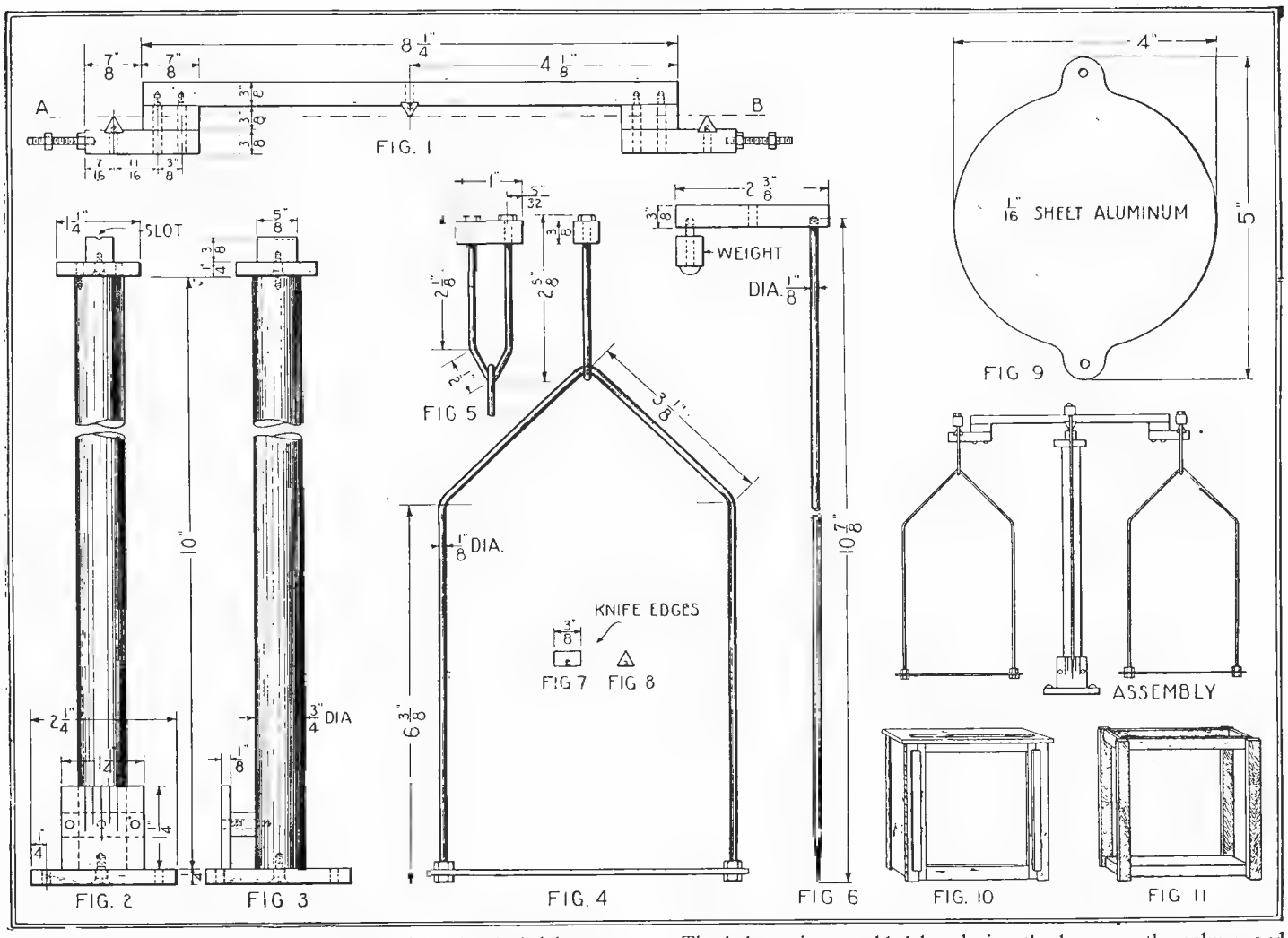
Constructing a Laboratory Balance

By L. J. SMITH

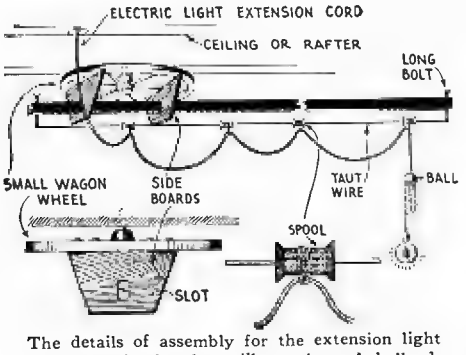


Complete details for the construction of a chemical laboratory balance are given above. The detailed drawings give all the necessary dimensions and show where the holes should be tapped. This balance may be used for accurate work as well as rough weighing and is strong enough to stand much abuse. All parts are of brass or aluminum except the knife edges, which are made of steel.

The balance is assembled by placing the beam on the column and suspending a pan from each end. If it fails to balance, interchange the pans, then add washers of brass until it roughly balances and finish adjusting, with the brass nuts on the adjusting screws. It is well to place the finished balance in a case in order to keep it free from dust and moisture.

PIVOTED EXTENSION LIGHT

AWARDED $10.00 PRIZE



The details of assembly for the extension light are shown in the above illustration. A ball adjuster is used to vary the height of the light.

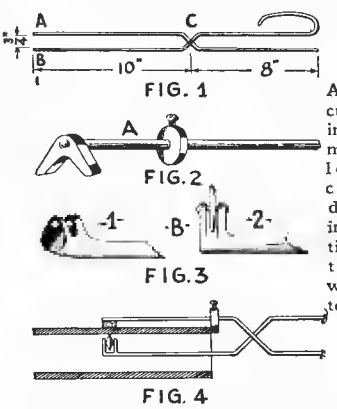
Two slide-boards are bolted vertically to opposite sides of a light wagon-wheel rim. The wheel is then pivoted to the ceiling with a long lag bolt. A piece of hard wood is cut to fit the slots in the slide-boards. An extension cord of sufficient length is attached to the socket and the electric-light lamp to be used. Tie the cord to the spools at various points to form loops in the cord when the spools are pushed together.—*L. B. Robbins.*

Hints for the Mechanic

A New Department!

BEGINNING with the May number we started this new department—"Hints For the Mechanic," in which we intend to publish wrinkles useful to mechanics in general. You can help us with this department by writing a brief description of your favorite shop wrinkle and sending this to the editor of this department, together with a pencil or pen and ink sketch of the wrinkle. The ideas published herewith will give you some idea of what we want. Our draughtsman will make the necessary mechanical drawings, so you need not send us finished drawings. We will pay $10.00 each month for the best Wrinkle or Hint sent in; others published will be paid for at space rates. Address all letters to Editor, Hints For the Mechanic Dept., in care of this magazine.

CUTTING GLASS TUBES



A simple glass cutter for tubing may be made by following the constructional details given in the illustration. A tool of this nature will cut tubes to any desired length.

Two pieces of ¼" steel wire bent according to the illustration are slightly flattened at the point marked C, a small hole bored and a pin fitted and riveted at this point. On the top rod a washer with a screw is fitted to limit the length. At the end A, a V-shaped piece of bronze should be riveted. The end B has two flanges, between which a small steel washer is placed. The cutter is inserted inside of the tube to be cut.—*J. Hazard, Reporter No.* 26808.

(*Continued on page* 177)

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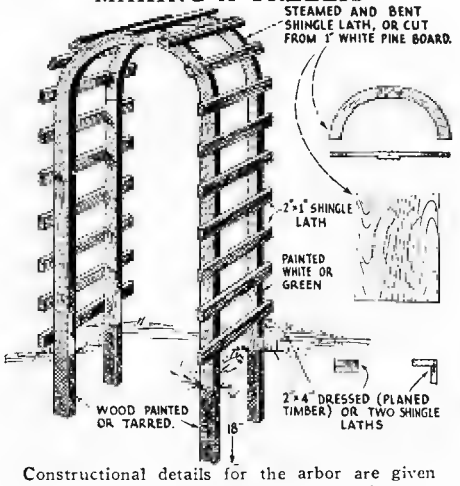
HOW TO MAKE IT

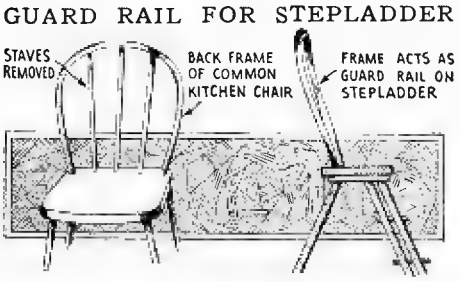
MAKING A TRELLIS


STEAMED AND BENT SHINGLE LATH, OR CUT FROM 1" WHITE PINE BOARD.
2"×1" SHINGLE LATH
PAINTED WHITE OR GREEN
WOOD PAINTED OR TARRED.
18"
2"×4" DRESSED (PLANED TIMBER) OR TWO SHINGLE LATHS

Constructional details for the arbor are given above. The curved portion at the top is made from a piece of board or by steaming and bending shingle lath.

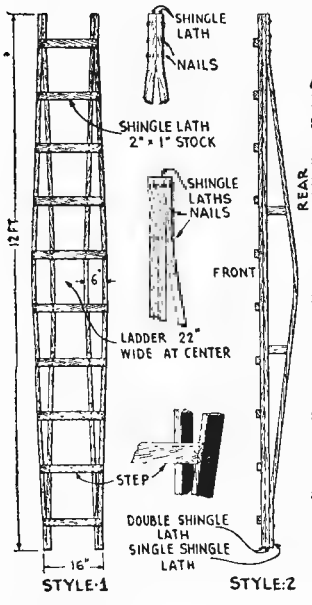
THE body of the trellis is made from 2x4-inch stock or from two shingle laths placed at right angles. The cross pieces consist of 2x1-inch shingle lath. The supporting members of the arbor project into the ground for a distance of about 18 inches.—*H. W. S.*

GUARD RAIL FOR STEPLADDER



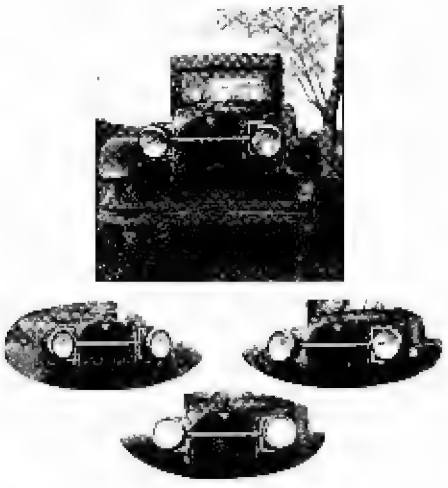
A handy grip for the top of a step ladder may be readily constructed from the back of an old chair. The ends of the chair frame are glued into holes which are bored in the top of the ladder. By slanting it at a slight angle a convenient grip is afforded.—L. B. Robbins.

LIGHT LADDER



An exceptionally strong and serviceable ladder may be constructed wholly from shingle lath. At the left the constructional details are given together with a front and rear view. The unusual bracing effect obtained by this method of construction strengthens the ladder greatly. The ladder is twelve feet long and twenty-two inches wide at the center.—H. W. S.

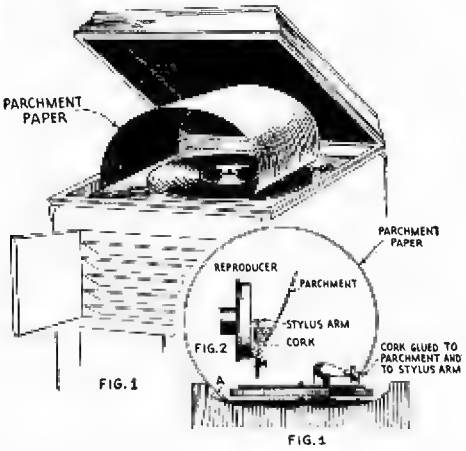
HEADLIGHT ADJUSTER



Four views of the unique device are shown above. The mechanism is operated from the dashboard by means of a small lever.

THIS device obviates the necessity of dimming the lights for an oncoming car. The lights may be adjusted to any angle to suit all conditions of driving. The metal rod, fitting the lights as shown above, is connected to the dashboard by means of a lever. When driving along a clear road the lights may be focused at such an angle so that a view 300 feet ahead is obtained. —*A. G. and William Meyer.*

BASE NOTES ON YOUR PHONOGRAPH

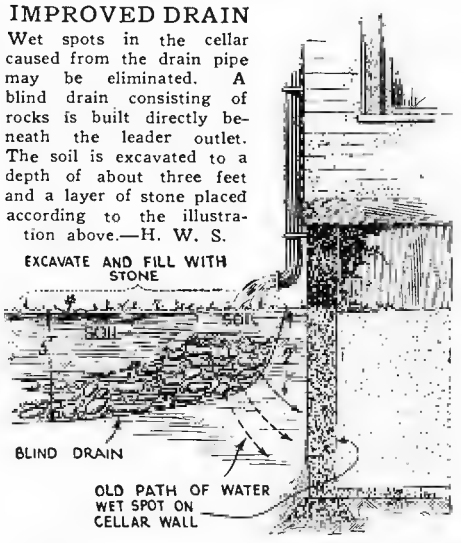


The above illustration clearly shows the method used for the production of base notes on the phonograph.

A SHEET of parchment paper is fastened to the needle arm of the reproducer in such a way that it is caused to vibrate when the needle passes over the record. The parchment is fastened to a piece of cork which is glued to the reproducer and is arched over the turn table of the phonograph. The parchment should be as large as possible and still not touch the lid or edge of the phonograph except at the point marked A.—*G. B. Ashton.*

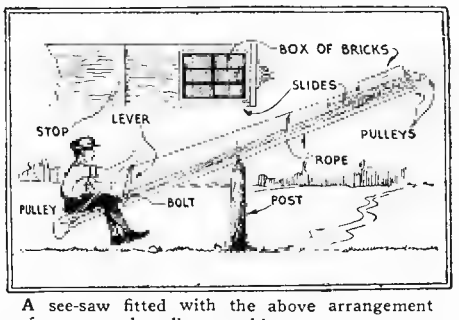
IMPROVED DRAIN

Wet spots in the cellar caused from the drain pipe may be eliminated. A blind drain consisting of rocks is built directly beneath the leader outlet. The soil is excavated to a depth of about three feet and a layer of stone placed according to the illustration above.—H. W. S.



BLIND drains are frequently required for carrying off water from leader pipes; in many cases blind drains made of stone as shown in the picture prove useful as an aid in drying up wet cellars. The longer the blind drain, the more efficient it will be.

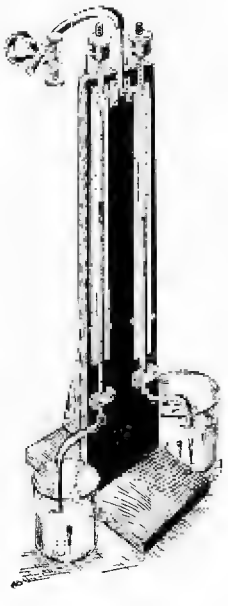
SEE-SAW



A see-saw fitted with the above arrangement of ropes and pulleys enables one to see-saw alone to his heart's content. A lever of wood placed on the right-hand side of the board operates the pulleys. The rope used should be kept taut its entire length.—L. B. Robbins.

DENSITY COMPARATOR

Two U-shaped tubes filled with a salt solution which is separated by castor oil are arranged as shown. An inverted Y-tube is mounted on an upright support. At the upper end a rubber tube is attached, allowing the operator to suck the air from the Y-tube, thus drawing the liquid from the beakers. The apparatus is first calibrated with distilled water. Next, one of the beakers is filled with a solution to be tested and the suction again applied. The heights of the liquids show an inverse ratio to their specific gravities.—Walter S. Brown.



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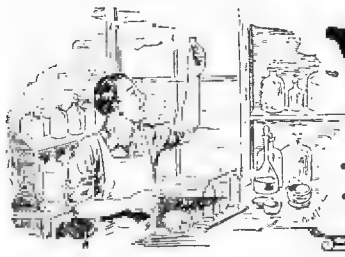
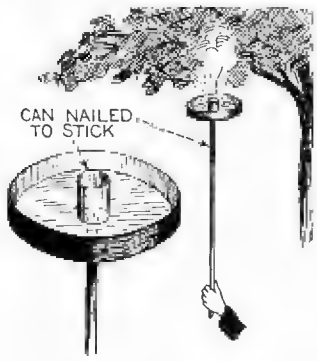


WRINKLES
RECIPES & FORMULAS

Edited by S. Gernsback

CATERPILLAR EXTERMINATOR

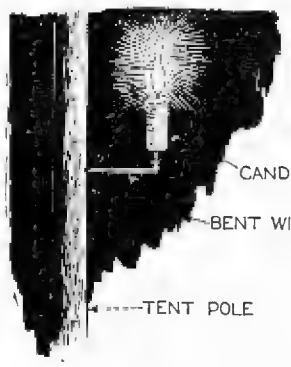


An efficient device for destroying caterpillars and their nests may be made from an old pan, a small can, a nail and a stick. The pan is nailed to the end of the stick and the can fastened in the center. A tuft of cotton soaked in oil is placed in the can.—Frederick E. Dunn. Reporter No. 28750.

BICYCLE ANTI-RATTLER

A bicycle spoke may be used as a combination anti-rattler and brace for the front fender. A hole is drilled in the fender and the spoke inserted, thereby holding it rigid.—Wistor Wright.

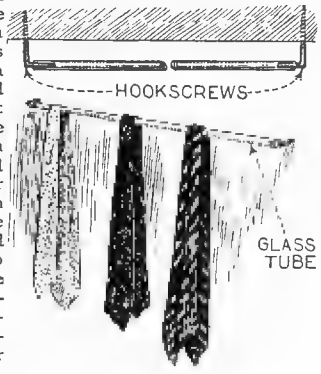
TENT CANDLE HOLDER



A candle holder for the tent may be made by taking a heavy piece of wire and bending it into the shape of the letter L. Sharpen one end and stick it into the tent pole with the short end projecting upward for the candle.—Fred Cornelius.

NECKTIE RACK

A tie rack may be made by securing a piece of glass tubing ¼" in diameter and about a foot long to the wall with a pair of hooked screws. After screwing both hooks to the wall, bend them open so that the tube may be inserted. — Pablo R. Moragon. Reporter No. 27502.

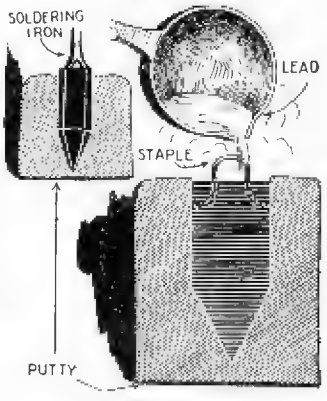


"LABEL SIGN"

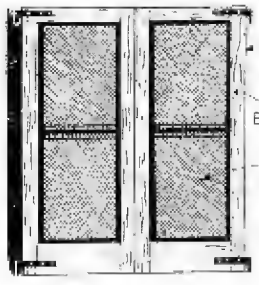
The "label sign" shown above is made from a piece of cardboard, celluloid and a few thumbtacks. Various signs are printed on the disk and the knob may be turned to any one desired.—H. S. Manuel, Reporter No. 20220.

MAKING SINKERS

Excellent sinkers may easily be made from a piece of lead and a staple. A form is made by burning a hole in a block of wood with a soldering iron or by pressing it into a piece of putty.—David T. Rayner.



SCREENS FROM OLD SHUTTERS

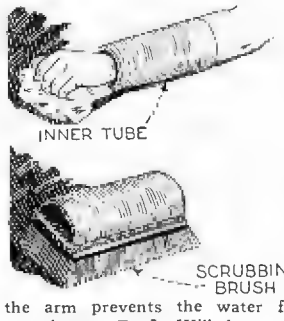


Screens may easily be made from a pair of old shutters by removing the slats from the frame and tacking screen wire in their place. — Salvador Foley.

RUBBER SLEEVELETS

The inner tubes of discarded balloon tires make excellent sleevelets when picking berries. The tube is cut to the desired length and slipped over the arm, thereby protecting the wearer from scratches. —William Agard.

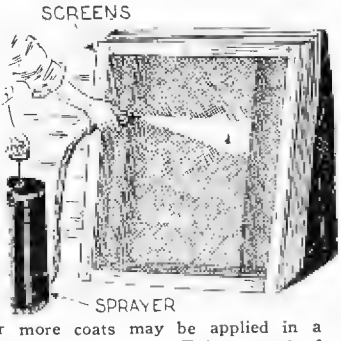
SCRUBBING KINK



A valuable aid to scrubbing may be made from two pieces of an old inner tube. A piece of inner tube is cut in half and tacked to the top of a scrubbing brush. Another piece of inner tube inserted around the arm prevents the water from running down the sleeve.—F. J. Wilhelm.

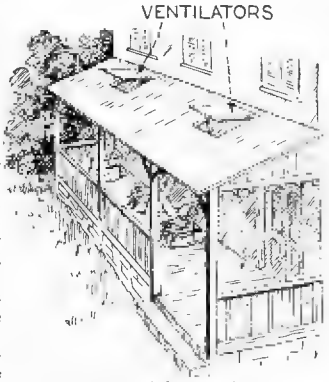
PAINTING SCREENS

At best the painting of screens is a tiring and tedious task. If an old garden spray, preferably of the reservoir type, is filled with a mixture of thin paint the painting is quickly accomplished. By using this method one or more coats may be applied in a short time and with great ease. This method of applying paint is especially recommended for use on wicker wear.



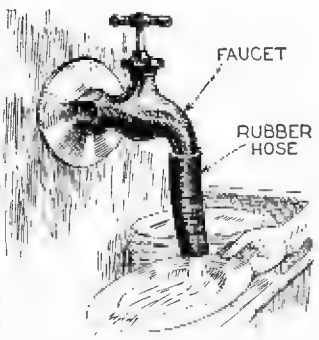
VENTILATING THE SLEEPING PORCH

Most sleeping porches are fairly cool when there is a good breeze astir, but are quite stuffy on a quiet night. The trouble lies in the fact that the warm air which rises strikes the low ceiling and cannot escape. To correct this defect in the ventilation, put two ventilators in the roof, one at either end.—Anna Wanley Pearsorn.



DISH-WASHING AID

If a piece of rubber garden hose is slipped over the end of a faucet it will prevent the dishes from being broken and also allow the stream of water to be directed into pots, pans, bottles and kettles more easily. This simple device is also of a great aid in washing out the sink as the stream of water may be directed into corners of the sink which would not be reached otherwise. —Leslie Carpenter.



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Readers Forum

SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them in both palatable and unpalatable forms. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words and address your letters to Editor.—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.

MATCHCRAFT MODELS—OF COURSE

Editor, SCIENCE AND INVENTION:

You are to be complimented on the February issue of SCIENCE AND INVENTION. I enjoyed reading it from cover to cover. The article on the Editorial page on Handicraft was very interesting. I am glad to see the Wirecraft Contest is a reality and forecast that it will prove even more interesting in developing inventive ability than the Matchcraft Contest. The article "Interesting Experiments with High Frequency Currents," by C. E. Newhouse, Jr., I liked, and am keeping it on file. I have performed many experiments in this line and have been giving electrical shows with high frequency as a part of them. I think the letters printed in Readers' Forum from some one in California, saying in part that Matchcraft takes little brain and is non-constructive, should have won a prize in Scientific Humor. Surely the author of that letter should have entered a Matchcraft Model, it takes so little brain and effort. Well, I must sign off, as I am making some more Wirecraft Models to send in soon.

A Booster for SCIENCE AND INVENTION,
LESLIE F. CARPENTER,
Burlington, Vt.

(There is very little that we need add to the above communication. Suffice it to say that Mr. Carpenter has won prizes in several of the contests featured by SCIENCE AND INVENTION *Magazine and has been a frequent contributor to the editorial columns of this publication.* -EDITOR.)

HAS WON A CUP

Editor, SCIENCE AND INVENTION:

Just got back from California yesterday, and so could not send a letter of thanks relative to the cup you helped me win in the Model Contest. The cup really is a fine trophy and has been admired by my friends who seem quite envious. I intend displaying the cup and model in some downtown window and giving SCIENCE AND INVENTION a boost that way.

Thanking you very sincerely for your efforts in my behalf and wishing SCIENCE AND INVENTION continued success,

J. H. JONES,
Denver, Colo.

(We are glad that you liked the cup, and certainly appreciate the models which you forwarded in an effort to win it. We would advise other model builders to submit their models in this prize cup competition. We find that there are many model builders in this country who do not think they can possibly win the cup, and are consequently loath to submit their suggestions as well as their models. Each model is returned to the builder after it has been photographed and the drawings have been made, and if it is the fortunate cup winner the cup is immediately sent to the model builder. Any type of model can be entered in this contest, and the one which was submitted by Mr. Jones, the writer of the above letter, was a Roman Ballista. Models of guns, trains, locomotives, ships, airplanes, submarines, and all types of mechanical apparatus can be entered. -EDITOR.)

FREEZING FISH

Editor, SCIENCE AND INVENTION:

In the August issue of *Amazing Stories* you state in the editorial that "it is possible to freeze fish and keep them frozen for months, after which they can be thawed out and revived." This statement was discussed at a meeting of the Amateur Scientific Association (of which I am president) and we also referred back to your SCIENCE AND INVENTION of September, 1925. On page 407 of that issue you state that "We first took a gold fish and put it in a cardboard tray. We then poured liquid air over it, and this froze the fish very rapidly. The boiling point of liquid air is —191 deg. C. or —311.8 deg. F. When the fish was thawed out afterwards in tepid water, he appeared dead." You then state that resuscitation was attempted electrically but that the fish was not revived. "The resuscitation process was continued for some minutes, but the fish did not return to life."

You also tried freezing fish by the artificial Frigidaire refrigeration, and by ice-freezing means, with the same negative results. Your next paragraph states that "The conclusion to be drawn from the experiments is that it is not possible to bring living organisms, after freezing, back to life."

Now what we want to know is whether your statement in the August issue of *Amazing Stories* is due to further experiments along these lines. If not, then why the positive statement that "It is possible to freeze fish and keep them frozen for months, after which they can be thawed out and revived."

I am not trying to criticize your statements or your magazines (indeed SCIENCE AND INVENTION is the official magazine of our society) but we wish to know the reason for these contradictory statements.

M. R. BERCOVITCH,
Montreal, P. Q., Canada.

(Our own experiments in freezing fish have never demonstrated that we can freeze them and thaw them out, bringing them back to life. During the past few years we have received many communications from writers throughout the country who have actually seen fish frozen in ice and brought back to life again. Of course this was done in a natural way and not in an artificial way. A great many other letters have been received from individuals who have cut fish out of blocks of ice in ice ponds, thawed them out, and the fish did not come back to life. We must assume, therefore, that some fish will, under certain conditions and in certain waters, be naturally resuscitated after the ice thaws; and that the same fish would probably be frozen by artificial means, carefully regulated so that both temperature of the air and temperature of the freezing water would be regulated as it is in Nature. A great deal of work can be done along this particular line to definitely settle the controversy one way or the other.—EDITOR.)

AMAZING STORIES

IN THE JUNE ISSUE:

THREE PRIZE WINNING STORIES: "The Visitation," by Cyril G. Wates; "The Electronic Wall," by Geo. R. Fox; "The Fate of the Poseidonia," by Clare Winger Harris, were selected by the judges, after much deliberation, as the best stories in the $500 contest for short stories written around the cover illustration of the December, 1926, issue of AMAZING STORIES. Each treats the picture in an entirely different manner, making each an ingenious and original story, distinctly individual.

THE MOON POOL, by A. Merritt. (A serial in 3 parts) (Part II.) In this installment, the Celtic mythology and the "underworld" Queen's annihilation of the criminal by vibrations are only small examples of the fantastic incidents and unusual science that permeates the succeeding chapters of this absorbing scientifiction classic. The story continues with increasing interest.

THE STORY OF THE LATE MR. ELVESHAM, by H. G. Wells; an unusual story with an extraordinary plot, which puts you in mind of "Station X," by Winsor MacLeod, although there is neither radio nor hypnotism in this story—a real mystery story, profoundly impressive.

THE LOST COMET, by Ronald M. Sherin, is an excellent story about a disintegrated comet, whose components have been lost from the view of the earth for many years, and which, according to the new cometary geometry invented by the scientist of the story, is due for a devastating visit.

THE FOUR-DIMENSIONAL ROLLER-PRESS, by Bob Olsen, is a very clever fourth-dimensional story, telling in layman language, what the fourth-dimension really is. Although we do not know enough about it yet to grasp the mathematics or mechanics of it, it seems logcial to us that mathematically, there is such a thing as a fourth dimension. It is a well-told, plausible story and makes excellent reading.

SOLANDER'S RADIO TOMB, by Ellis Parker Butler. In his inimitable style, the famous author of "Pigs Is Pigs" gives us the humorous angle of the radio-fan and radio. If you are planning to provide in your will, for the installation of a loud speaker in your private vault, it would be well to read this story first, for the intricacies of radio are great, and the unexpected occurs often.

"UNHEARD" SOUNDS

Editor, SCIENCE AND INVENTION:

We have been discussing whether a sound has been made or not by a tree *falling in a forest where there is no ear* to hear it. Will you please enlighten us? Thanks.

J. B. CAMERON,
Pinchurst, N. C.

(This is an age-old problem and may be argued both pro and con. Actually, however, a sound is made by a falling tree in a forest, even when there is no ear there to hear it. You might just as well ask whether or not the Niagara Falls roars at the present time when you yourself are not there to hear it. The human ear is not necessary to register a sound. Were we to take a recording phonograph and place it either at the Falls or in the forest, that recording phonograph would record the noise or sounds produced. This sound can later be re-transmitted to us and we would all hear it. It is obvious that were it not produced it could not be recorded. Let us assume that we place a microphone in the forest and connect that microphone with a pair of cables to a broadcasting station. We could then transmit the noise produced by the falling tree to hundreds of thousands of listeners, who would at no time be anywhere near that forest. Coincidentally, Niagara Falls roars all the time. It has done this for ages, probably even before man appeared on this planet. -EDITOR.)

FAKE RADIO DOCTOR

Editor, SCIENCE AND INVENTION:

In the January issue I read your article entitled "Beware the Fake Radio Doctor" and a I have had treatment by a somewhat similar machine I was more than interested. I am a chronic sufferer from stomach trouble, which many doctors have pronounced ulcers. During the summer I heard of a doctor in Norfolk, Va., who was curing stomach troubles by electricity, and I took treatment by his method. I took a two-hour treatment, six days a week, for ten weeks, at $5 a day, and know I was benefitted as long as I took treatment and for about two months after I was discharged. I don't know whether or not this was imagination or not. That I will leave to you.

I have explained my condition and the length of treatments for your knowledge of my condition. The name of the treatment was the Electronic Reactions of Abrams. If you can tell me whether this method of treatment is a fake or not will be highly appreciated. I hope I have not taken up too much of your time by explaining my troubles. This is for my own information and is not intended to cause trouble one way or the other. If you want to publish this letter or any part you are at liberty to do so except my name and address which I would like kept in confidence. If I can give any further information, I will be only too glad to do so.

A READER.

(Several years ago SCIENCE AND INVENTION *Magazine published an exposé on the methods of the Electronic Re-actions of Abrams, as well as the possible results which could be obtained with this mechanism. In this particular article we doubted the possibilty of the mechanism doing any of the things which it was claimed to do and as a matter of fact, we definitely proved that such things as actual diagnosis could not be obtained with the instrument. It was demonstrated at that time that relatively pure cultures of pathogenic organisms did not give accurate readings. The Journal of the American Medical Association has repeatedly published articles showing how E. R. A. practitioners were trapped by means of blood serum taken from guinea pigs, chickens, etc., in which the diagnosis given indicated diseases only found in man. We are of the opinion that any benefit in your particular case has been of a mental nature, rather than of a physical nature. While the time may come when diseases will be diagnosed and treated purely by machinery, no such instrument has as yet been discovered. All of the various systems claiming to operate on electronic principles have been either foolish in their construction or entirely incorrect in the principle of operation. Generally the inventors try, by means of baffling semi-technical phrases, to instill an air of mystery about their mechanisms. They do not realize that sometimes the investigator knows as much about electrons as they themselves. Sometimes the operator will guess the disease correctly, at other times he will not do so and more frequently he will fail. Fortunately for the patients, many will get well whether they are treated or not. Nature has a remarkable property of restoration. The physical effect of looking at a monstrous machine and watching many dials moving around has an effect on the patient which cannot be discounted. We do not think that you were physically benefitted $300 worth, but it does not make much difference which way your health improved, as long as it really did. That is, after all, the most important consideration.*—EDITOR.)

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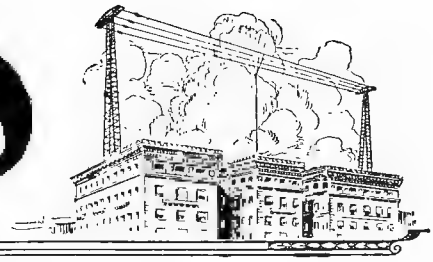
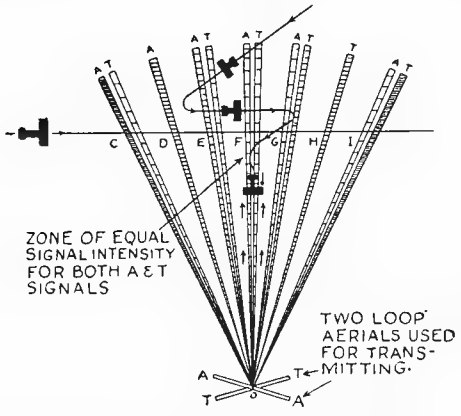
RADIO



Radio Beam Directs Aircraft

By PAUL WELKER

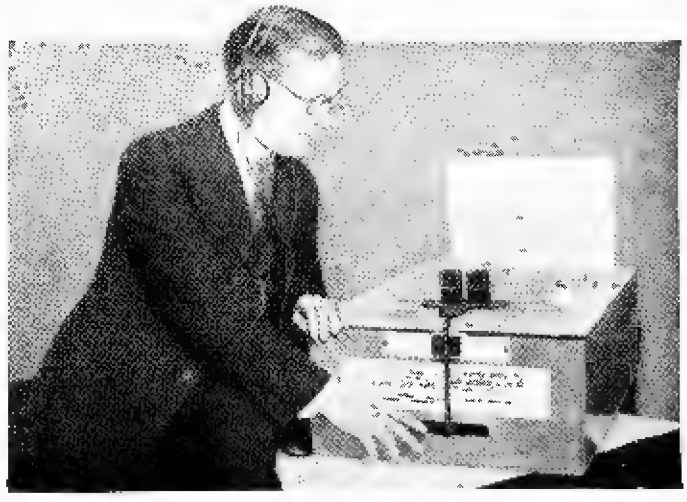
THE directive type of radio beacon was tested on ship-board and on airplanes recently by the U. S. Bureau of Standards. The guidance of a ship or airplane by means of signals sent from a particular type of beacon and their application to navigation was made apparent by this test. Interesting results were obtained as a result of tests made with an airplane. It was found that the directive receiving characteristic of an ordinary trailing wire antenna caused an apparent shift of the equisignal zone in the direction of flight of the plane, when it was flying at right angles to the zone of signals. The use of a heavy antenna weight, which caused the antenna to hang more nearly vertical, eliminated this zone-shifting effect. While this aid may be effective only over a definite course, it has the advantage over other methods of direction finding, in that no special receiving apparatus is necessary.



The above diagram illustrates by means of shading the relative signal intensity received from the two transmitting loop aerials.

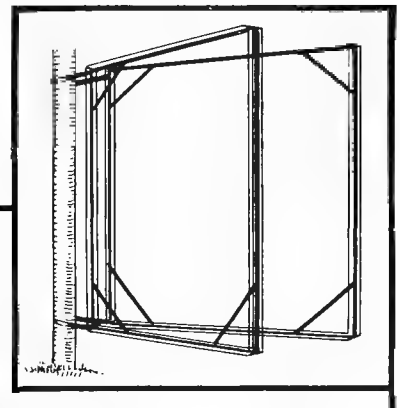
The beacon itself consists of two transmitting coil-antennas, arranged at an angle of 135 degrees with respect to each other. These coil-antennas are arranged to be connected alternately to a radio transmission set by means of a special switch, which is thrown rapidly from one closed position to the other, thus emitting two different signals. Waves are thus intermittently propagated directively from each coil, the intensity with respect to the plane of the coil varying in accordance with a figure-of-8, which is the characteristic obtained with these directive antennae. An airplane equipped with an ordinary receiving set, if located on any bisector of the angles formed between the two coils, will receive signals of equal intensity from both of them. Thus, a definite course may be held simply by navigating so that the signal strength from the two coil-antennas remains equal. By referring to the illustration, it will be seen how an airplane would receive a loud signal from coil A, and a weak one from coil T; at D the signal from A is not as strong as at C, and the signal from T has become inaudible.

Signals were transmitted from the Bureau of Standards by means of two single-turn coil antennas, 120 by 50 feet, crossed at a 135-degree angle and alternately connected to a 5-kilowatt transmitting set. The equisignal zone was found not to exceed a width of 500 feet up to 50 miles from the transmitting station. As the distance from the transmitting station increased, the sharpness of the zone decreased. With an airplane using a 200-foot trailing wire antenna, it was found that the signals were stronger when the plane was flying away from the transmitter than when flying towards it, due to the directional characteristics of the trailing wire-antenna. It was found by using a shorter antenna with a heavy weight that the zone displacement effect was eliminated to a large extent. The use of a coil-antenna in place of a trailing wire was effective, but could not be worked over a great distance.

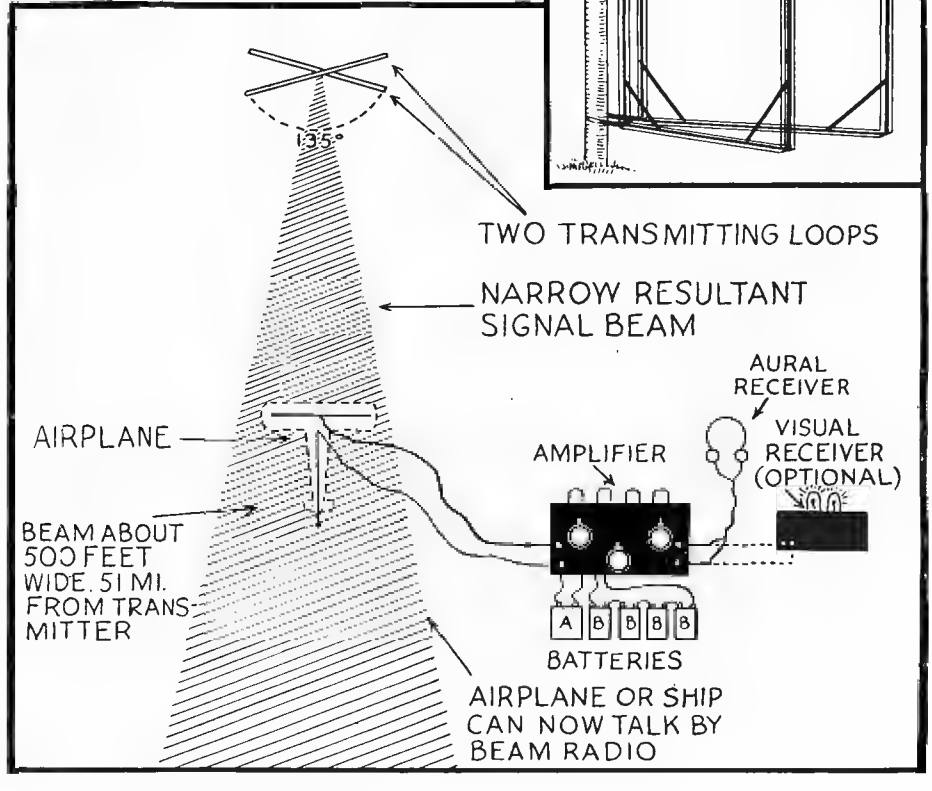


Mr. J. P. Buckley of the U. S. Bureau of Standards is shown demonstrating the new airplane radio director which has been perfected by the Bureau.

The experimental type of equisignal double-coil antenna which is arranged to rotate about a telephone pole as an axis.



The diagram below shows how directive radio communication is made possible.



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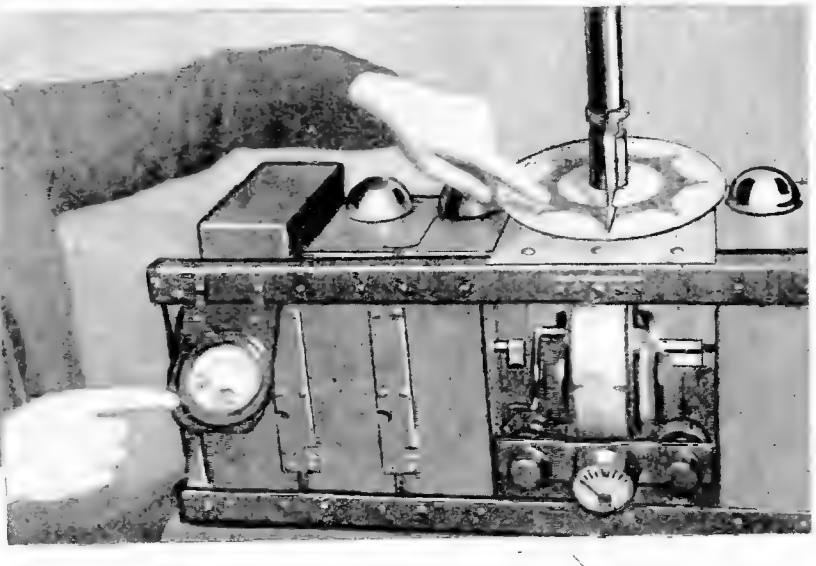
Pictures Show Radio Progress

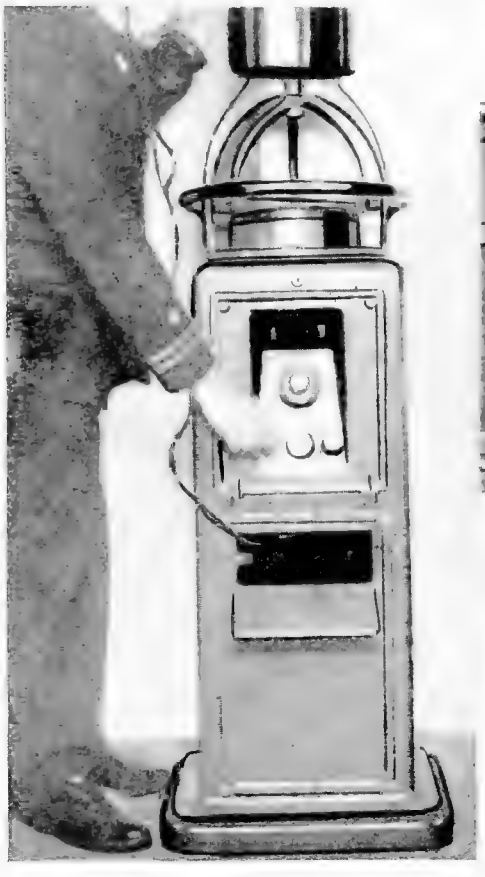
A new direction finder perfected recently will enable ships to determine the exact position of an oncoming vessel without relying to the uncertainties of audible signals. Joseph D. Freed is shown pointing to the milliammeter which tells when a ship has been definitely located.

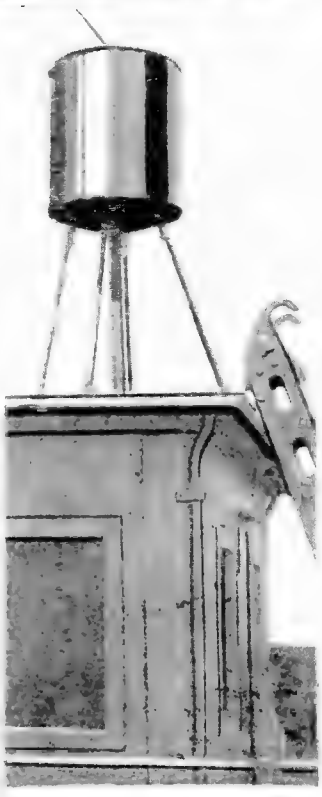
Forty-four steamers on the Great Lakes are now equipped with this new radio device and it is entirely possible that the transatlantic vessels will use similar devices soon. The new finder is automatic and leaves nothing to human frailty. A dial swings until zero is reached and then the pointer indicates the exact position of the signaling ship. The milliammeter tells when the ship has been definitely located by registering when the signal from it becomes weakened.



A new super-radio position detector and direction finder is being installed on the United States Survey Ship "Guide." The photograph below shows a view of the instrument itself which has an illuminated dial for work at night, an eight-tube receiving set and an entirely closed loop which is protected, by rotating doors, from adverse weather conditions.

Interference records are being made for the Radio Control Board by Eric H. Palmer in his home at Brooklyn, New York. In order to give evidence of heterodyning between stations from 200 to 2,500 miles apart, mushy signals are registered on wax cylinders. In this way a perfect record is kept and will be sent to Washington, D. C., for use when the Board starts reallocating the wavelengths.





The photograph above shows part of the equipment which is used in connection with the new super-radio position detector and direction finder. This instrument is capable of registering a location with an accuracy of one degree in fifty miles. The sense of direction is said to be one hundred per cent accurate. If the tests prove successful the government is contemplating placing these new machines on all the ships of the survey fleet.

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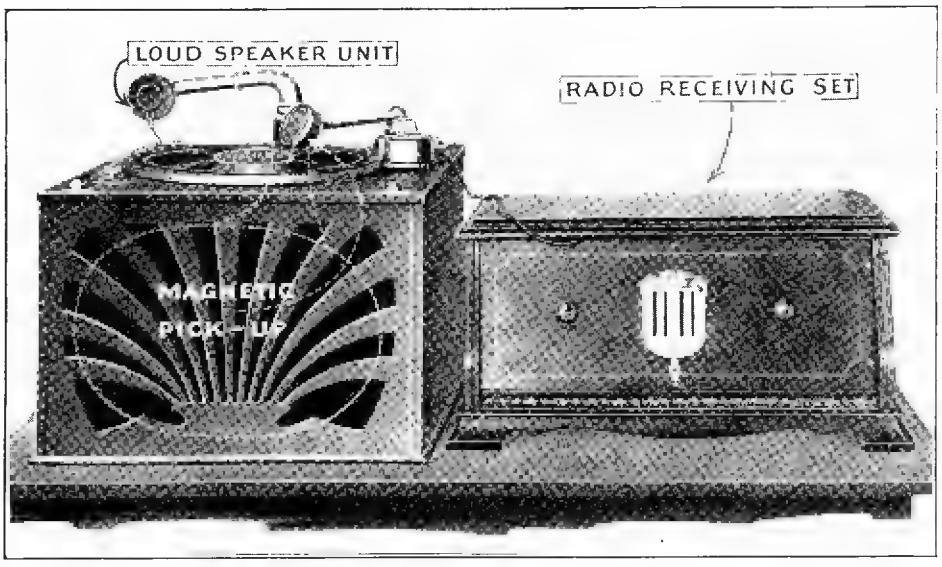
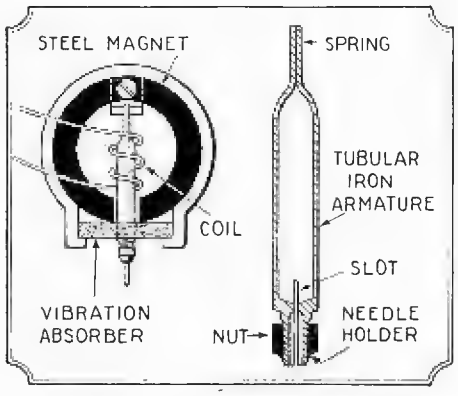
New Phonograph Pick-Up

By C. W. PALMER



The electrical pick-up device in working position. The device is situated on the right-hand side of the phonograph, the two leads going to the radio set. The phonograph horn is used as a loud speaker.

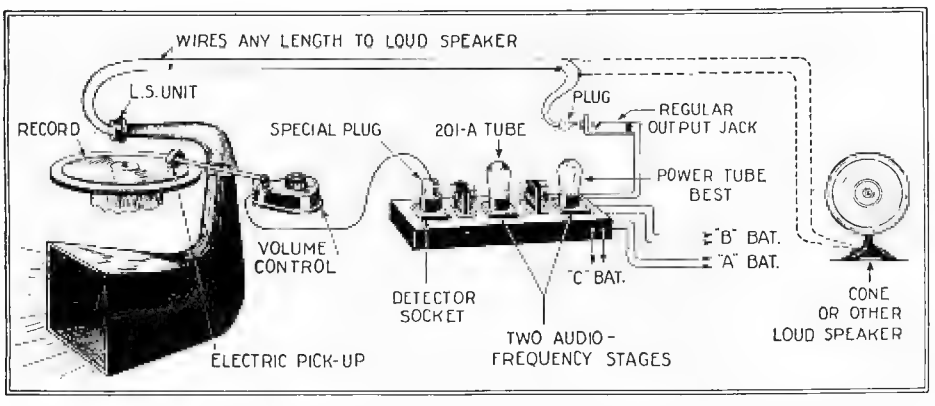
THIS new electrical pick-up reproduces music with utter clearness, doing away with the scratchy noises and overtones usually super-imposed upon reproduced music due to the natural period of vibration of the various parts of the reproducers themselves, without hampering or distorting the reproduction of the desired sounds. In this electrical pick-up the armature and the stylus holder are extremely light so as to offer practically no inertia resistance to the stylus in exactly following the wavy grooves on the record, and yet they are stiff enough so as not to bend in transmitting the vibrations from the record. In this way distortion is entirely eliminated. A special "deadener" is placed on the armature, preventing vibration. The purpose of the "deadener" is twofold. Without it the armature has a natural period of vibration determined by the weight of the vibrating parts and the strength of the spring. In reproducing selections all of the notes in the record which are of the same pitch as the natural period or vibration of the armature will be unduly amplified and hence distorted reproduction results. Also if the stylus holder and armature are light enough to vibrate freely at high frequencies, so that the highest musical notes will be reproduced, the "scratchy" noise, so common in phonographs, will also be reproduced. Both of these difficulties, however, are overcome by means of the novel construction and careful selection of materials in the "deadener." To reproduce low notes correctly, the vibrating system must be very limber. The elastic "deadener" of large diameter offers very little resistance to the movements of the armature at low frequencies, as the full elastic value of it comes into play.



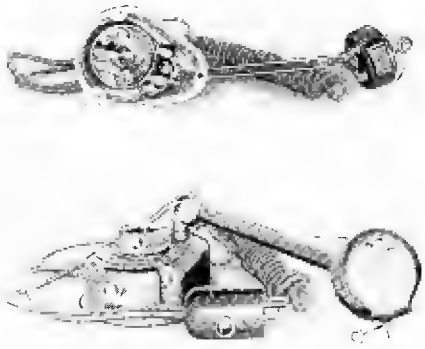
A sectional view of the armature, stylus holder and reproducer showing its novel, unusually light and inflexible construction.

The novel stylus holder is several times lighter than a conventional set screw type. The armature stylus holder and pivot spring are all made out of a single piece of iron, as shown in the illustration. The armature composed of paramagnetic material swings between the two poles of a permanent magnet, with a pivoting spring at one end connecting it with the neutral portion of the magnet and a needle holder at its other end. A wire coil surrounds the armature.

The pick-up device is situated adjacent to the phonograph with the needle resting upon the record. The plug P in the illustration below is inserted in the detector socket of the radio set. The volume is controlled by the variable resistance R. The arm holding the needle has a ball and socket joint and is free to move in any direction. It is usually found convenient to secure a loud speaker unit to the end of the tone arm, thereby using the phonograph horn itself as a loud speaker. The house can be completely wired and jacks inserted in each room so that entertainment may be had in any part of the home. It is not necessary to use the audio amplifier which is in the radio set. A special amplifier may be built for this purpose and installed in the phonograph cabinet. If a great amount of volume is desired power tubes may be employed in the audio-frequency amplifying unit. The type 171 tube with a high "B" battery voltage works well in the last audio stage when a 201A-type tube is employed in the first audio. With this type of electrical pick-up device the reproduction is smoother and clearer than that of an ordinary phonograph and all the undesirable noises are entirely eliminated. The use and pleasure derived from this device more than repays one for the initial expense. For dancing the pick-up is indispensable, as the music is amplified many times and may be heard in every part of a large room or dance hall. Another outstanding feature of this pick-up system is that the volume is controlled by a single knob. In these times, when almost every home is equipped with a phonograph and a radio set, this novel device should become quite popular.



The above schematic diagram shows clearly the method for connecting the electrical pick-up and audio amplifier. The phonograph horn may be utilized or a separate loud speaker employed which may be installed in any part of the house. For great volume a power tube may be used in the last audio stage.



Two views of the electric pick-up, one showing the base removed and the other showing the unit completely assembled.

Photos courtesy Crosley Radio Corp.

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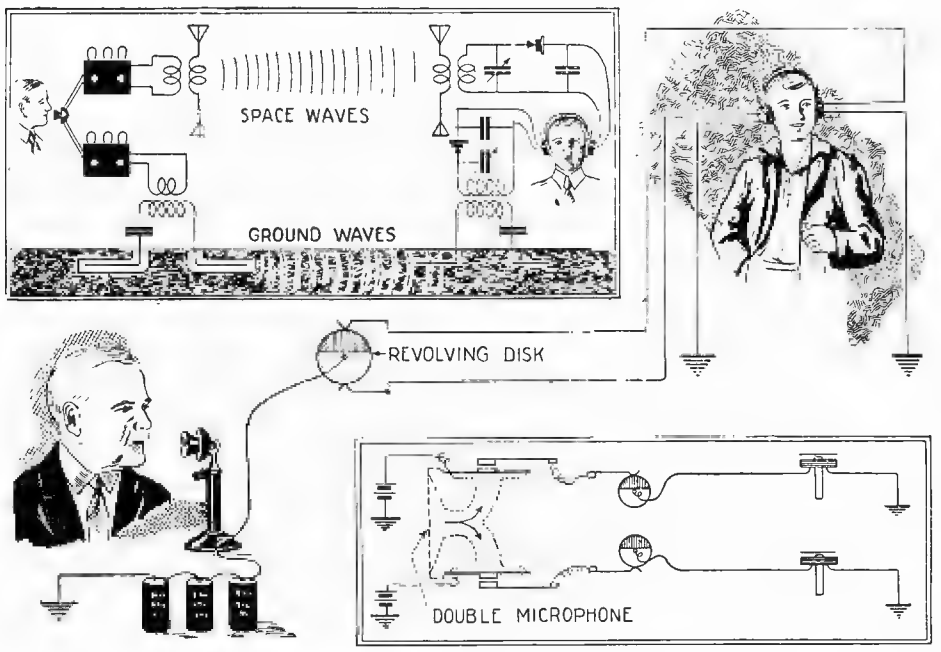
Secret Radio Communication

By S. R. WINTERS

AN invention on the borderland of physics and physiology offers possibilities as a means of secret communication by radio. The process requires the use of two different wavelengths sent out simultaneously from two transmitters. Articulate speech, for example, is first spoken into a double microphone or telephone transmitter. A revolving disk cuts the speech into fragments. Then, one portion of the fragments of this seemingly hopeless jumble is transmitted on one wavelength and the component or other group of scrambled words is sent on another wavelength. In traveling through the ether this unintelligible jumble of speech could not be intercepted by radio listeners.

If the two radio circuits are listened to simultaneously the fragments of speech or signals are reunited and are once more understandable.

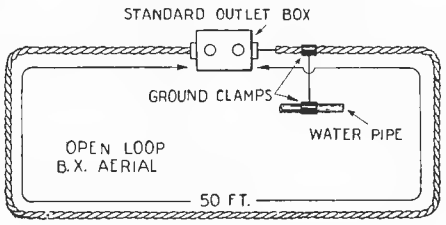


The illustrations at the left show clearly the method of secret radio communication. The patent was granted on this device just forty-six years ago and as the protective measures have expired a fertile field of experimentation is presented to all radio amateurs.

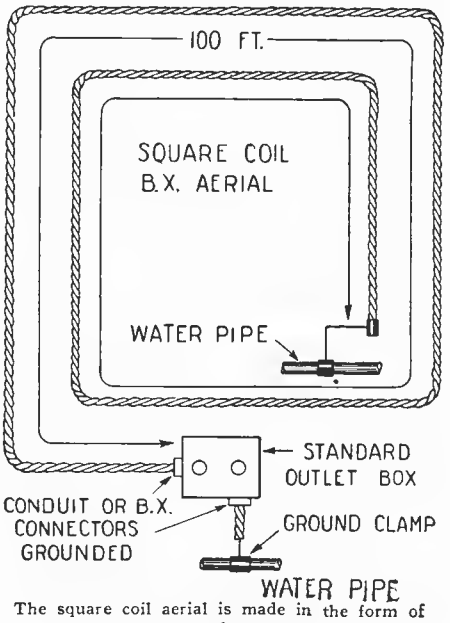
Unique BX Aerial

By JOSEPH HANHAUSER

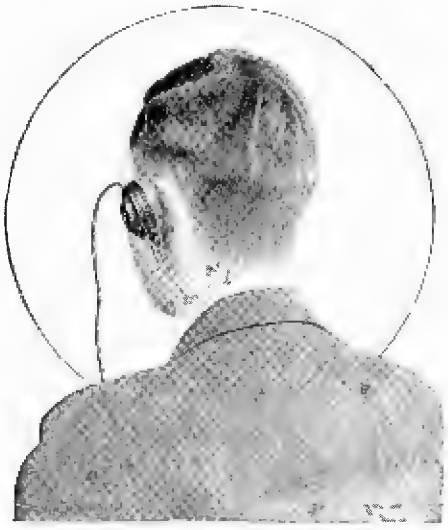
THE BX aerial can be used in more places than the usual types and does not need supporting poles to hold it up. It can be installed under floors, over ceilings, inside of partitions or even outside of the building. It does not require insulators, as the armor forms a continuous shield about the aerial wire, thus eliminating much interference when the shield is grounded. It conforms to the Fire Underwriters' Rules because it incloses the conductor in one continuous metallic circuit from the dead end to the outlet box for connection to the receiving outfit. This type of aerial may be easily installed or the electrical contractor may put it in when the building is being erected, thus doing away with all outside wires on the roof or other parts of the building. The three types of aerials which were found to work best are illustrated on this page, but there is much room for improvement and experimentation.



In the open loop type of aerial the black wire is connected to the aerial post and the white wire to the ground post.



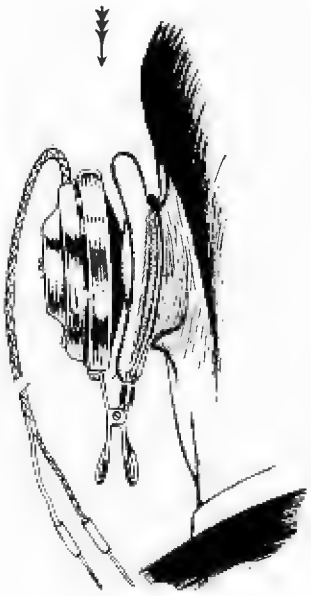
The square coil aerial is made in the form of a pancake coil.



Mr. B. B. Bryant is shown above wearing the new head phone which clamps directly on the ear.

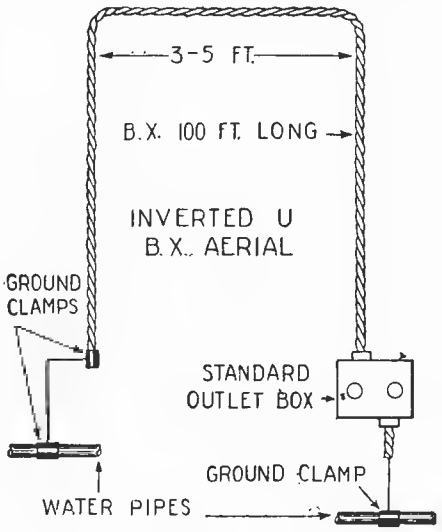
NEW EAR PHONE

A NEW ear phone has recently been perfected in France. This novel device has a thin metal band which clamps the receiver directly on to the wearer's ear, thereby eliminating the use of a head band. The phone is extremely light in weight and does not inconvenience the wearer.



The inverted U type aerial will probably give the best results and can be fastened right to the wall or even buried in a concrete floor.

The sketch at the left shows plainly the details of new French radio ear phone. The clamp fitting around the ear and the novel construction should be noted.



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One Tube Radio and Cabinet

By H. L. WEATHERBY

IN these days of radio if we are not "listening in," we feel pretty much out of it all, and there is really very little excuse for one not to have a radio set, when with a few pleasant hours of work the music of the world is brought to our homes. The cost of the set need not be prohibitive, when a large share of the five and ten cent stores stock the parts that go into its construction.

About the simplest hook-up that one can use with good results is that of the one-tube, three-circuit tuner. The set illustrated, gathers up music and speech from the air, over a radius of several hundred miles. Two or even three sets of head phones may be used satisfactorily.

Let us first see to the construction of the set itself. Purchase the parts as indicated, the prices given being "five and ten" prices and of course only approximate, since they will vary with locality, quality and store. They will, however, give the purchaser a general idea as to cost of material.

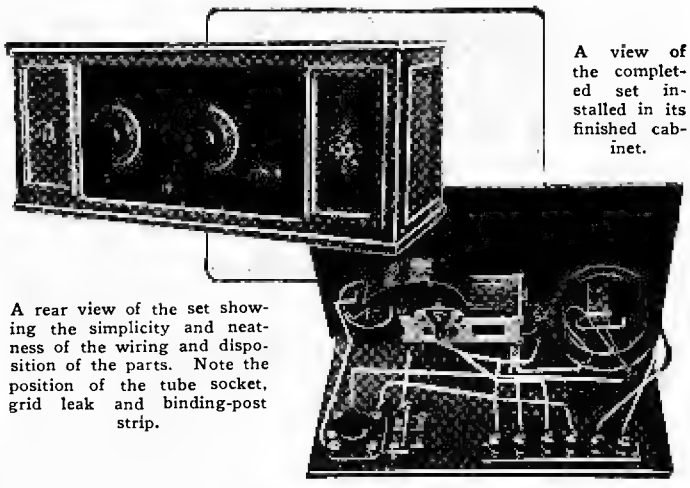
Directions, as indicated on the drawings, along with illustration and diagrams will show even the novice the method of "hooking up" his parts. Care must be taken to make good soldered joints, and a good resin core solder should be used rather than acid. A small soldering copper, preferably electric, will be more convenient than one of a larger size.

With the set constructed, we can turn our attention to the cabinet, which is really no small part of the job and which, if it is going to grace the home, should be made as good looking as possible and should care for all batteries. The one illustrated is lacquered a jade green and has appropriate floral decorations on the panels. There are no hinges to fit, as the set slips in and out of the box easily. The lacquer colors are very popular, easily applied and lend themselves well to decoration.

The actual construction is very simple. Cut the two ends, bottom, top, front and back to dimensions. Cut the opening for the radio set in the front piece, noting that a small rabbet goes all of the way around this opening on the inside, permitting the panel of the set to fit snugly into position. Nail these pieces together, with the exception of the top, using 1½" wire brads and butt joints. Now nail and glue a mitred frame of ⅜"x1" material to the bottom of the top piece, making it to fit the inside of the cabinet.

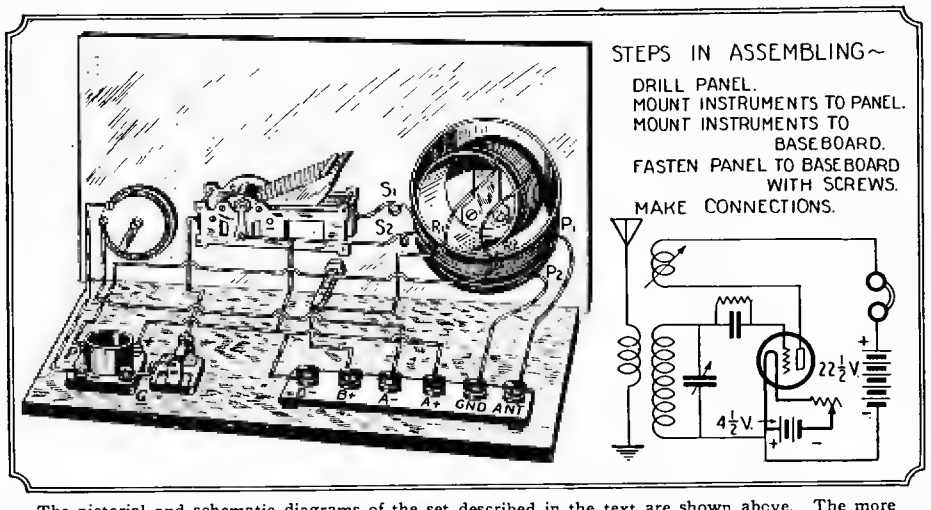
Next, we add a touch of decoration, by nailing with small brads, the moulding forming panels in front, on the ends and around the edges of the top and bottom. Set (counter-sink) all nails and fill the nail holes with putty or filler and then give the entire job a thorough sanding with medium and then with a fine grade of sandpaper. Be sure to bore two holes in the back, for the ground and antenna wires.

The material, if purchased three ply, comes already sanded and will save the builder a great deal of time with plane, scraper and sandpaper. However, an ordinary grade of lumber, poplar or even pine, will answer very nicely. If stain and varnish are used, more care must be taken in selecting the wood and in finishing than if either enamel or lacquer is used.



A view of the completed set installed in its finished cabinet.

A rear view of the set showing the simplicity and neatness of the wiring and disposition of the parts. Note the position of the tube socket, grid leak and binding-post strip.



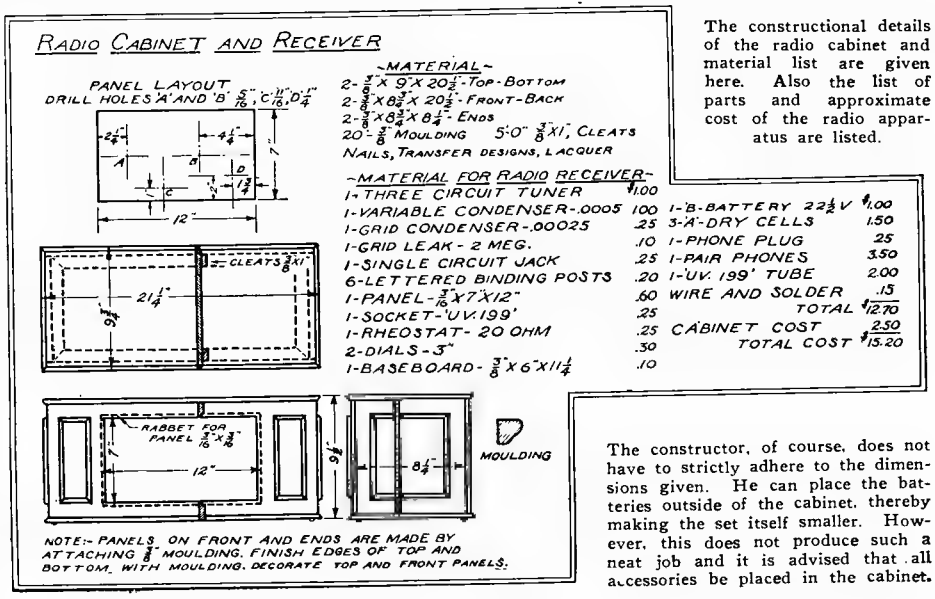
The pictorial and schematic diagrams of the set described in the text are shown above. The more experienced set builder will of course use the schematic hook-up, while the novice will appreciate the other diagram. Note the placement of parts on the panel.

The painting done, a touch of decoration on the panels and the top will add greatly to the appearance of the finished cabinet. Purchase small transfer patterns from your local paint dealer and apply them, according to directions, to these spaces. Their application is simple and results are very gratifying.

Tack four rubber headed tacks to the bottom of the cabinet, and it is ready to receive the set. A little outside work, installing antenna and ground connections, and the fun begins.

If the directions given are followed closely the mere novice will have no trouble in turning out a neat, efficient and compact radio set which he will be proud of. The set, which uses a UV199 tube, is very economical in operation and the upkeep is nil. If more volume is desired the builder may add one or two stages of audio frequency amplification. This will necessitate enlarging the cabinet and radio set in order to accommodate the two extra tubes, transformers and batteries.

Now as summer is once again approaching, portable sets are becoming popular. The receiver described here can readily be changed into a self contained portable set, by constructing a carrying case instead of a cabinet and leaving room for the accommodation of batteries and head phones. It might also be well to provide a space for a coil of wire which could be used for the antenna. One stage of audio frequency amplification may also be incorporated in the set without greatly adding to its weight and size. With a good aerial and ground connection this receiver may be expected to give excellent results, when used as a portable.


RADIO CABINET AND RECEIVER
PANEL LAYOUT
DRILL HOLES 'A' AND 'B' 5/16", 'C' 11/16", 'D' 1/4"
~MATERIAL~
2- ¾"X 9"X 20½"- TOP-BOTTOM
2- ⅜"X 8¾"X 20½"- FRONT-BACK
2- ¾"X 8¾"X 8¼"- ENDS
20'- ⅜" MOULDING 5'-0" ¾"X1", CLEATS
NAILS, TRANSFER DESIGNS, LACQUER
~MATERIAL FOR RADIO RECEIVER~
1-THREE CIRCUIT TUNER $1.00
1-VARIABLE CONDENSER-.0005 1.00
1-GRID CONDENSER-.00025 .25
1-GRID LEAK - 2 MEG. .10
1-SINGLE CIRCUIT JACK .25
6-LETTERED BINDING POSTS .20
1-PANEL-3/16"X7"X12" .60
1-SOCKET-'UV-199' .25
1-RHEOSTAT- 20 OHM .25
2-DIALS-3" .30
1-BASEBOARD- ¾"X 6"X 11¼ .10
1-'B'-BATTERY 22½V $1.00
3-'A'-DRY CELLS 1.50
1-PHONE PLUG .25
1-PAIR PHONES 3.50
1-'UV-199' TUBE 2.00
WIRE AND SOLDER .15
TOTAL $12.70
CABINET COST 2.50
TOTAL COST $15.20
CLEATS ¾"X1"
RABBET FOR PANEL 3/16"X⅜"
MOULDING
NOTE:- PANELS ON FRONT AND ENDS ARE MADE BY ATTACHING ⅜" MOULDING. FINISH EDGES OF TOP AND BOTTOM, WITH MOULDING. DECORATE TOP AND FRONT PANELS.

The constructional details of the radio cabinet and material list are given here. Also the list of parts and approximate cost of the radio apparatus are listed.

The constructor, of course, does not have to strictly adhere to the dimensions given. He can place the batteries outside of the cabinet, thereby making the set itself smaller. However, this does not produce such a neat job and it is advised that all accessories be placed in the cabinet.

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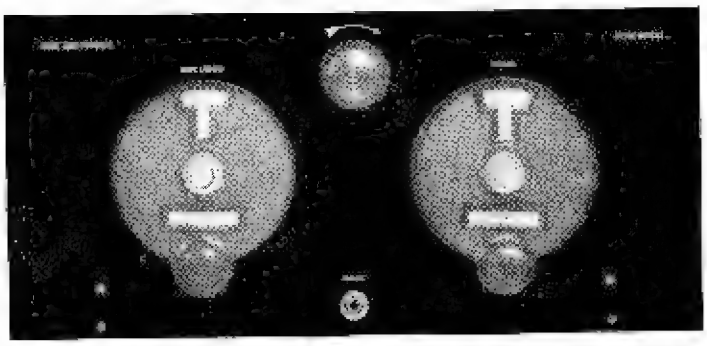
A Proven Short Wave Set

By CHARLES H. CALLIES



A front view of the set showing the placement of the dials, rheostat and jack. Note the attractive appearance of the set and the simplicity of the front panel layout.

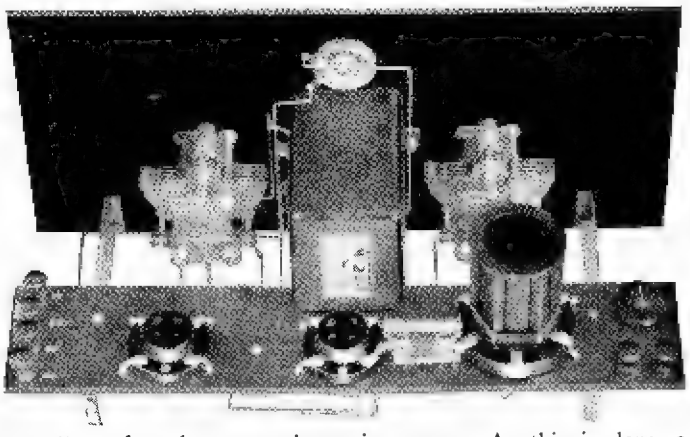
A rear view of the short wave receiver showing placement of parts. Note that the audio frequency transformer is mounted on the panel directly and is supported by the base.

THE receiver that is about to be described is one covering a range of 18 to 150 meters—a circuit with a regenerative detector and one stage of audio amplification. The two tubes will not give quite the volume that is needed for good speaker reproduction, but the set was built with the idea of feeding the output of this receiver into a stage of power amplification—a power pack. It is a very simple matter to add another stage of transformer coupled audio, making proper allowances for increases in the panel and baseboard size. The short wave rebroadcasting comes in with such clarity and beauty of tone, as compared to the regular reception, that the original idea of using the output coupled to a power amplifier gives us a tone that is probably sweeter than anything we have been accustomed to.

This assembly is not only efficient to the nth degree, but it presents a compact and pleasing exterior—a good-looking unit of radio apparatus. The receiver in the illustration is built around a panel 7 by 15 by 3/16 inches. The two dials on the front, reading from left to right, are first the single tuning control and, second, the dial affecting the regeneration. At the top and in the center, we have the control on the filament of our two tubes. This is either a Carter or Frost 6-ohm rheostat. At the bottom in the center is our output jack. These are the only visible items on the front panel with the exception of the four little screws holding the brackets. The two screws that separate the audio transformer are invisible—they are under the edges of the two dials and, of course, the screws are flat head and countersunk. The audio transformer, because of its four pound weight, has also been placed in the exact position where it will be supported by the baseboard as well as by screws on the front panel.

On our baseboard, which is 3 by 14 inches, reading from right to left, and looking at the set from the rear, we have the aerial and ground binding posts with the knob controlling the compensating condenser immediately above. Next we have our coil socket. Our grid condenser and leak are soldered directly to the contacts on the coil socket and the tube socket. Therefore, in mounting the coil socket be sure that the No. 3 post is in such a position that it will make this direct connection possible. The tube socket immediately in front of the audio transformer is our detector socket, and the next one is our first audio. To the extreme left we have our four binding posts for our current, the one farthest from the front panel being the positive 90; the next the positive 45; the next the negative "A" and negative "B" and, finally, the positive "A" which is closest to the front panel. The screw between the two-tube sockets supports the choke coil. The condenser between the plate of the amplifier tube and the positive "A" is soldered in somewhere under the audio-tube socket—where it will fit the best. Looking at the front panel from the rear we see all our controls and no mistake can be made here.

The antenna may consist of a single wire 30 to 50 feet long, stretched between two suitable supports, preferably outdoors. It might also be located indoors, if necessary, strung around the picture moulding or in the attic. The ground connection should be a good one preferably leading to a water pipe.



In preliminary testing the aerial coil, which is the one that has next to the smallest amount of wire on, should be inserted in the coil socket and the antenna coupling condenser should be turned all the way in. The rheostat which also serves as a switch, should be turned on to about the normal operating voltage of the tubes. With the phones plugged in, the receiver may be tested with the left-hand or antenna condenser set approximately half way in or at the "50" setting on our scale. The regenerative condenser is then to be turned slowly over its entire range. As this is done, a "plunk" will be heard at some point indicating that the receiver has gone into oscillation. Possibly if the regenerative control condenser is increased further, a steady squeal will be heard. If the pitch of the squeal varies with a slight adjustment of the antenna tuning condenser, it indicates that a station is being heard.

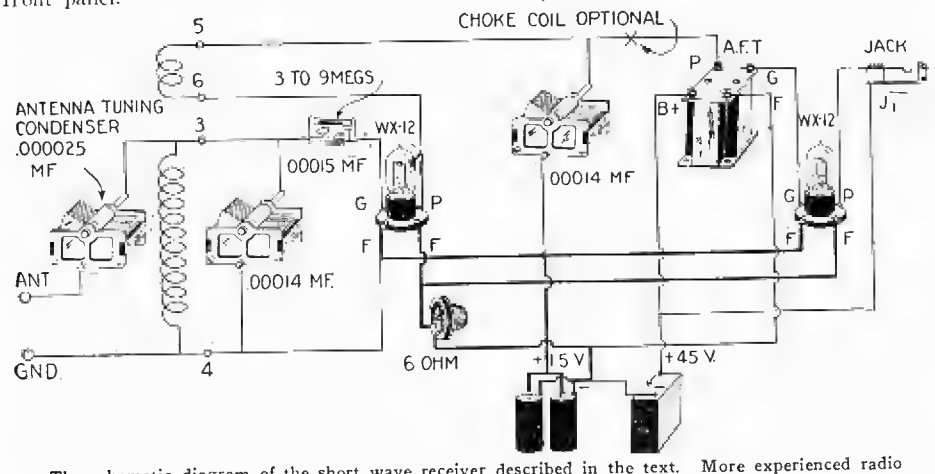
The complete list of parts which are employed in the assembly of this unit follows:

LIST OF PARTS

2 vernier dials.
1 6-ohm rheostat.
1 1-spring jack.
1 short wave kit (2.00014-mf. condensers, 1 set coils 18-150 meters with socket, and antenna condenser.)
1 audio-frequency transformer.
2 tube sockets.
1 pair brackets.
1 .00015-mf. condenser with grid leak clips.
1 7-megolm resistor.
1 choke coil.
1 7x15x3/16 panel.
1 3x14x3/16 panel.
6 binding posts.
Wires, lugs, screws, etc.
(*Names of manufacturers of parts for this set supplied on request.*)

THE TOOLS REQUIRED IN BUILDING THE SHORT WAVE SET

Pliers, several kinds.
Screw drivers, several sizes.
Hammer, hacksaw and blades.
Hand drill.
Twist drills, several sizes.
Scriber.
Center-punch.
Soldering iron, electric or other type.
Wire solder, self-fluxing or plain solder and non-corrosive flux.
Rule, steel or wood.
Center finder for dials.
1 three or four cornered reamer and handle for expanding panel holes for shafts, jacks, etc.
Small tool and awl handle very useful.
Volt and ammeters for testing set and batteries.
1 countersink.



The schematic diagram of the short wave receiver described in the text. More experienced radio fans will doubtlessly follow this hook-up. At the point marked X in the diagram a choke coil may be inserted, but this is optional with the builder. Two or more dry cells connected in parallel should be used for the operation of the 1½ volt tubes.

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RADIO ORACLE

In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.

TESTING TRANSFORMERS

(542) H. F. Hayes, Nome, Alaska, writes:

Q. 1. Please tell me how to test audio frequency transformers for short circuits and slight defects.

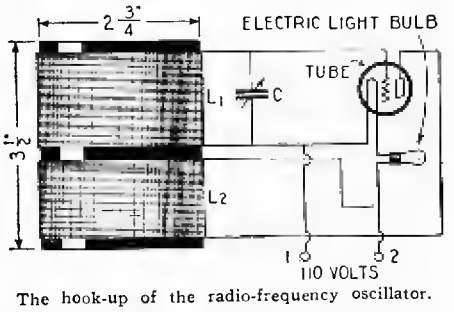
A. 1. Audio frequency transformers can be tested by means of a 40-watt light in series with the regular light lines and transformer windings. The test is made for both the primary and secondary. The lamp should light with somewhat less than normal brilliancy when in series with the primary and should not light when in series with the secondary, there being a slight sparking at the terminals, when the connection is made and broken. If you do not want to try this, you can use a voltmeter or ammeter in series with the battery and the winding of the transformer. If a short circuit exists, the reading will be practically the same as if the two ends of the test leads were connected directly together, but if there is no short-circuit, the reading should be considerablyably less when the transformer is in the circuit.

R.F. OSCILLATOR

(543) O. Berjeau, Arlington, N. J., asks:

Q. 1. Will you publish the necessary data for the construction of an R.F. Oscillator deriving its power from the lighting mains?

A. 1. A diagram of a simple oscillator that takes all of its energy from the power mains is shown on this page. A unit such as this is quite useful to the home constructor in making tests on receivers. It sends out energy in much the same way as any broadcasting station, and it can be tuned to deliver this energy at any frequency between 500 and 1500 kc. (600 and 200 meters). It makes use of a 201A tube and will operate on 110 volts either AC or DC. If the latter is



The hook-up of the radio-frequency oscillator.

used, the device will only function when terminal No. 2 is connected to the positive side of the line. The coils, L1 and L2 may be wound on a single piece of tubing 3½" long, having an outside diameter of 2¾". L1 consists of 50 turns of No. 26 D.C.C. wire, and L2 spaced ¼" from L1, consists of 40 turns of the same size wire. Both coils are wound in the same direction.

The condenser, C, should have a maximum capacity of .0005 mfd. Any ordinary electric light bulb of 25 watt rating is shown in the circuit. If by any chance the oscillator is to be used on a 220 volt circuit, the electric light bulb should be replaced by one suitable for use on this voltage, and should be rated at 50 watts. If this oscillator is supplied with alternating current and is placed within a few feet of the receiver, it will be possible to tune-in the signal generated by it if the receiver is in good condition. The note heard will be a low pitched hum. If the unit is supplied with direct current it will not be directly audible. However, if the receiver is of the regenerative type it will be possible to produce a heterodyne whistle, when the set is oscillating.

"SUPERHET" TROUBLES

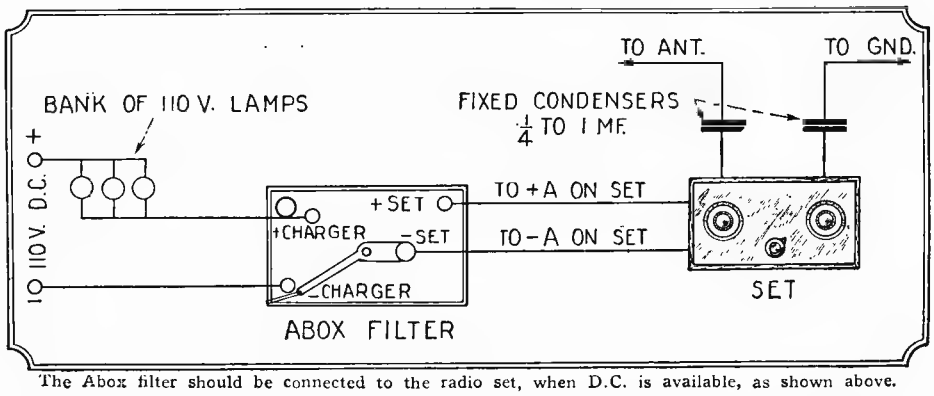
(544) B. H. Blaker, Westfield, N. J., writes:

Q. 1. I hooked up a superheterodyne using Victoreen transformers, following the circuit shown in the current number of *Radio Review*. It does not work satisfactorily. Can you tell me where the trouble might lie?

A. 1. We believe that what has happened is that you have followed the Madison-Moore hook-up a little too faithfully in wiring your Victoreen transformers. The Victoreen transformers can be used, but where you got into trouble was when you hooked up the oscillator coupler.

You will note in looking over the recent article in *Radio Review*, that in the Victoreen circuit the oscillator variable condenser is really connected across both windings, *i. e.*, the total inductance of both windings is used in shunt with .0005 condenser. In the Madison-Moore hook-up the .0005 oscillator variable condenser is connected across only one of the oscillator coupler windings, and in consequence you only reach to about 300 meters.

The thing to do is to follow the Victoreen hook-up in connecting up the oscillator coupler with particular respect to the oscillator variable condenser, but take care to connect the pick-up coil in the plate circuit of the first detector, as the Madison-Moore circuit indicates.



The Abox filter should be connected to the radio set, when D.C. is available, as shown above.

ABOX FILTER

(545) John Hannigan, Painted Post, New York, writes:

Q. 1. I recently purchased an Abox filter from a friend, and as he lost the diagram that came with it, I am unable to connect it properly. Will you please publish the correct method for using this filter with D.C. current.

A. 1. The simple installation shown on this page is recommended. Connect three ordinary lamp sockets in parallel and then connect the bank in series with one side of your direct current supply and between the line and the Abox filter. By varying the rating of the lamps, receivers consuming varying amounts of current may be operated. The following table shows the rating of lamps to be used in the bank for varying amounts of current required by the receiver:

Current required by set	Rating of lamps in bank
1 ampere	140 watts
1¼ "	165 "
1½ "	190 "
1¾ "	220 "
2 "	250 "
2¼ "	275 "

Note that it will be necessary to place a ¼ to 1 mfd. fixed condenser in series between the ground connection and the set and another fixed condenser of similar capacity between the set and the antenna. A direct current charger can be used with the Abox filter to operate your radio set. However, if the current supplied by the charger is more than ¾ amperes in excess of the current required by your set, we do not recommend its use as it will run up your light bill and cause the Abox filter to require very frequent additions of distilled water. If a direct current charger is used it should be connected through the Abox Filter to the set, the same as any other type of charger, and ¼ mfd. to 1 mfd. fixed condensers should be connected between ground and set, and between antenna and set as shown in the diagram.

AMPLIFICATION FACTORS

(546) Harry D. Reirs, Merton, Neb., asks:

Q. 1. Why is it that while tubes intended for radio frequency amplification usually have a high amplification factor, audio frequency, and especially power tubes, have a much lower one?

A. 1. If the amplification factor were the only thing to be considered, doubtless all tubes would have a high one. However, there are a great many other things to be considered when designing a tube. For reasons which need not be stated here, a high amplification factor means a high impedance. Now a high impedance means that the plate current will be comparatively small if ordinary "B" battery voltages are used, so that when a large plate current is required it is necessary for the impedance to be low and incidentally, of course, also the amplification factor. Radio frequency amplification should only be used when signals are weak, and in these circumstances a large plate current is not necessary. What is necessary, however, is a high amplification factor, as there is little or no step-up effect in radio frequency couplings. Consequently, high impedance tubes, with high amplification factors are generally used in radio frequency stages. For audio frequency amplification, on the other hand, a large plate current is essential if great volume is to be obtained. Although this means that low-impedance tubes with low amplification factors must be used, the disadvantage of the latter is overcome by using step-up transformers between the audio frequency stages.

R.C.A. CONE

(547) J. Constantine Vecchio, Rockville Center, L. I., asks.

Q. 1. Can you tell me the thickness of the parchment diaphragm used in the R.C.A. loud speaker?

A. 1. The diaphragm parchment is about 7 mils thick. The first diaphragms however, were made of a good quality of wrapping paper.

TROUBLE IN THE VICTOREEN

(548) R. C. Andover, Ironwood, Michigan, writes:

Q. 1. I have a Victoreen radio and would like to know if I can place the coils straight, instead of on an angle as it would make a better job. I am bothered with a lot of interference and I think by shielding I will reduce some of it.

A. 1. If you shield your Victoreen and have shielding between the stages, so that the coils you refer to are in separate compartments the angular placement can probably be done away with. Before bothering to put in the shielding, remove the loop (or antenna and ground) from the set and see whether the noise decreases or is entirely eliminated. If all the noise stops when the pickup systems are removed, shielding will do you no good, as your pickup of noises would be entirely through the antenna.

IMPROVING A T. R. F. SET

(549) K. Milton, Barnegat, N. J., asks:

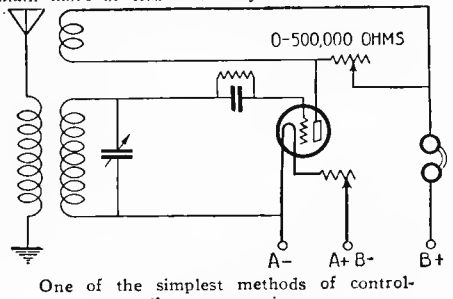
Q. 1. I have a five-tube T. R. F. Set and desire to improve its sensitivity and selectivity. Can I add another tube, and how, in order to do the above?

A. 1. Instead of adding another tube we would suggest that you either reduce the primaries of the radio frequency coils, or add regeneration to the detector. This can be done by winding a three-inch coil with 20 turns of No. 22 D.C.C. wire and placing it at the grid end of the detector coil. This coil, should of course, be wound in the same direction as the detector coil. A variable resistance, say from 0 to 50,000 ohms can be used, shunted across this coil to control regeneration.

CONTROLLING REGENERATION

(550) A. Sohn, Bronxville, New York, asks:

Q. 1. Can you give me a method for controlling regeneration whereby the tickler coil can remain more or less stationary?



One of the simplest methods of controlling regeneration.

A. 1. You will find illustrated on this page a simple and efficient method for the controlling of regeneration by means of a high resistance in the tickler leads. Although the circuit shown here is a standard three-circuit receiver this method may be used in any circuit which employs regeneration. The resistance should have a range of about 0 to 500,000 ohms.

FREQUENCY AND WAVELENGTH

(551) F. Kuntz, Jacksonville, Florida, asks:

Q. 1. Can you give me formulae for determining the frequency when the wavelength is known and vice versa?

A. 1. To ascertain the frequency when the wavelength is known use the following formula:

$$\text{Frequency in kilocycles} = \frac{300{,}000}{\text{Wavelength in meters}}$$

To ascertain wavelength when the frequency is known, the formula becomes:

$$\text{Wavelength in meters} = \frac{300{,}000}{\text{Frequency in kilocycles}}$$

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Scientific Humor

ARTISTS BOTH—THEY DRAW

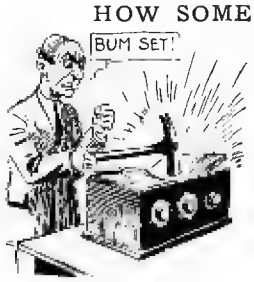
PATIENT (in dentist's chair): Wow! They told me you were a dental genius, but I could have pulled that tooth myself. I didn't imagine, beforehand, it would pain me so much, either.

DENTIST (suavely): They do call me an artist, and I draw your tooth, from life, but it does not follow you have a similar genius, because you draw pain from your imagination.—*Ashley N. Chandler.*

PARAPHRASING BUICK

When better locomotives are made, Westinghouse will brake them.—*Smith O'Brien.*

HOW SOME TUNE



A man seeing his friend walking down the street with a radio set under his arm called out, "How do you like the new radio set?"

FRIEND: The bloomin' thing is no good."

FIRST MAN: How's that?

FRIEND: The dealer told me I could tune in Los Angeles on the seventh tap. Well, I tapped the set seven times and didn't get a sound.—*Burl Knutson.*

MARKING THE PLACE

JIM: "They couldn't find any pieces of that aviator after he lit."

WILL: "But I heard there was a funeral held."

JIM: "They just filled up the hole he made and put a tombstone over it."—*John H. Spicer.*

PROOF CONCLUSIVE

LITTLE FRANK: What makes you think that street cars are being run by electricity?

LITTLE MARY: Because they start and stop shockingly.—*Paul S. Katigbak.*

THIS JOKE WAS HALF REFUSED

AVIATOR: "Dandy little 'plane that. Nice fuselage, too."

FIRST BYSTANDER: "What's fuselage?"

SECOND DITTO: "I know; that's a lot of guns going off at once."

THIRD DITTO: "You're wrong, that's fusilade. Fuselage is a kind of glue."—*Harvard Taft, Rep. No. 27,958.*

A LENGTHY YARN

JINKS: The story about the discovery of rubber is very interesting.

BLINKS: I suppose it was stretched a lot.

First Prize $3.00

MAKING IT HOT FOR THE STUDE

CHEMISTRY PROF: If you wanted to make a salt solution in a hurry, would you use hot or cold water?

STUDENT: I'd use cold.

PROF: Cold! But why cold?

STUDENT: Well, if I was in a hurry, I wouldn't want to take the time to heat the water.—*James P. Kinton.*

SHOCKING

TEACHER: How do you make hydrogen?

PUPIL: It is very simple. All you must do is electrocute water.—*Willy Walker.*

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. We cannot return unaccepted jokes. Please do not enclose return postage.

All jokes published here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to tie for the prize, then the sum of three dollars in cash will be paid to each one.

HOT ICE

CHEM. PROF: Name some liquid that won't freeze.

STUDE: Hot water. — *Milton Roberts.*

WIND PROOF

HE: Why did you shingle your hair?

SHE: Just to make it weathertight and keep the colds out of my head.—*John H. Spicer.*

ONLY NEEDED A LEAN MIXTURE

A man driving a very large car on a country road found that he was out of gas with only forty cents in his pockets, so he drove up to a gas station and said, "One gallon of gas, please."

The garage keeper looked surprised. "What are you trying to do, wean it?" he asked.—*Ernest Wench.*

NOT ECLIPSED YET

MR. HENPECK (in a sudden spirit of bravado, reading): Well, Henrietta, I see that you have a real rival at last.

MRS. HENPECK (bristling): A real rival at last? What do you mean, Henry?

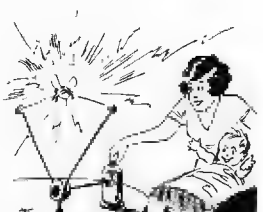
MR. HENPECK: Well, this article says that the new transatlantic cable has a capacity of 2,500 words a minute, or 41 2/3 words a second.—*Smith O'Brien.*

NO GROUNDS FOR BELIEVING THIS YARN

ELEC. PROF.: "Define a grounded circuit."

BRIGHT PUPIL: "A grounded circuit is a circuit to which the Earth has been accidently or purposely fastened.—*James L. Breslove.*

BEE—LEAVE— ME!



MRS. MCFANN (on telephone, weeping): Oh, John, there's a big bumble bee in the house! He's buzzing around the baby, and I'm afraid he'll sting the darling. I don't know what to do!

MCFANN: Nonsense, Janet. Switch on the "B" eliminator.—*G. T. Evans.*

TAKE OFF ONE AND USE THE OTHER

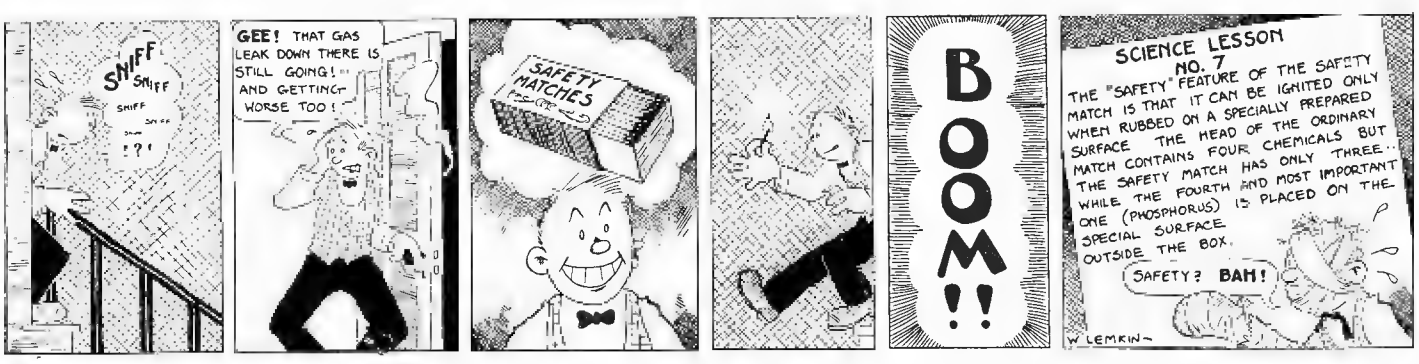
PLANT OPERATOR (to assistant): "Dumbell! I thought you told me you turned on the street lights at 6:30. For two cents I'd —well—the generator near you is a liar identical with yourself!"

ASSISTANT (meekly and gulping): "How —how come?"

PLANT OPERATOR: "Two-phased!"

—*J. Leo Vandeheyden.*

SCIENTY SIMON, SCIENTIST


SNIFF SNIFF
SNIFF
SNIFF
!?!
GEE! THAT GAS LEAK DOWN THERE IS STILL GOING!... AND GETTING WORSE TOO!
SAFETY MATCHES
BOOM!!
SCIENCE LESSON NO. 7
THE "SAFETY" FEATURE OF THE SAFETY MATCH IS THAT IT CAN BE IGNITED ONLY WHEN RUBBED ON A SPECIALLY PREPARED SURFACE. THE HEAD OF THE ORDINARY MATCH CONTAINS FOUR CHEMICALS BUT THE SAFETY MATCH HAS ONLY THREE... WHILE THE FOURTH AND MOST IMPORTANT ONE (PHOSPHORUS) IS PLACED ON THE SPECIAL SURFACE OUTSIDE THE BOX.
SAFETY? BAH!
W. LEMKIN

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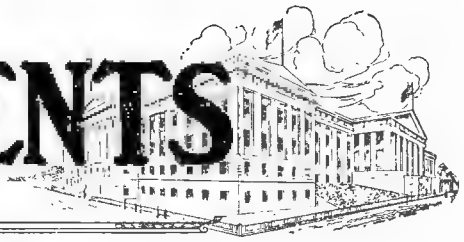
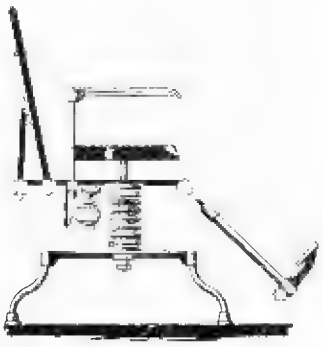
LATEST PATENTS



STRINGED MUSICAL INSTRUMENT

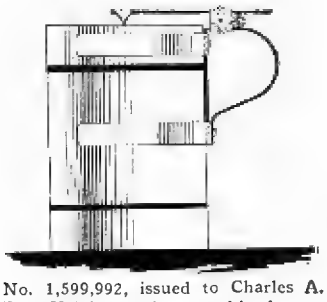
No.. 1,600,061, issued to Earl Pagett. This novel musical instrument consists of a stringed instrument of the violin type mounted on a horn. A sound box and a vibrating diaphragm are placed under the strings.

VIBRATING CHAIR



No. 1.615,615, issued to Michael F. Cannon and Orville Markel. The device shown above is a vibrating chair to be used in medical treatment. An unbalanced shaft driven by a motor causes the chair to vibrate back and forth.

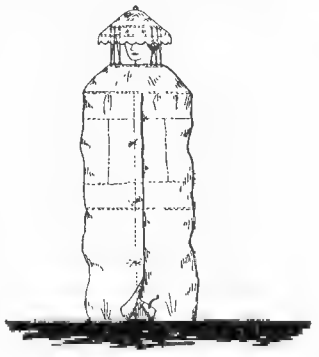
MILK-CAN OPENER AND HOLDER



No. 1,599,992, issued to Charles A. De Velbiss. The combined can opener and holder has a pair of circular clamps which extend around the milk can, a handle which rests against the can and an opener pivotally mounted on the handle. This device combines an opener, a stopper or sealer and a holder.

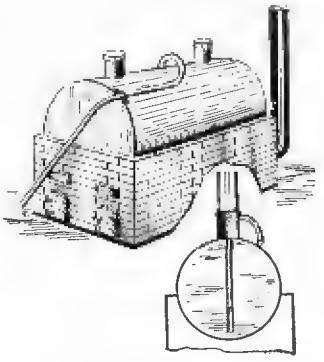
PORTABLE SCREEN FOR BATHING PURPOSES

No. 1,599,798, issued to Louisa Emma Stockton. This portable bathing screen combines a shoulder piece having two loops carrying a fabric cover. A fabric screen extends from the shoulder to the feet and has a vertical slit or opening in the front.



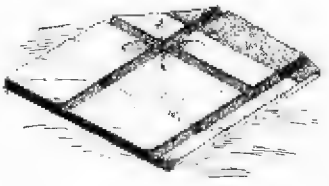
TOY

No. 1.604.187, issued to George M. Miller. The drawings above show a cross-section elevation and a perspective view of this toy. The toy comprises a receptacle having a filler hole and a siphon tube permanently secured in the receptacle. The toy represents a diminutive refinery and may readily be tilted to start the siphon action.

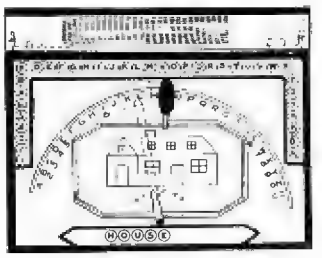


MIRROR MAKING

No. 1,604,459, issued to Robert E. Lyons. The process of making this mirror consists in applying a non-metallic color-film to the surface of the glass to be decorated, treating such color-film with a solution which renders it wettable and applying to the treated color-film the solution used in depositing the desired mirror-metal.



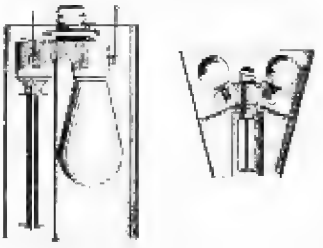
SPELLING TOY



No. 1,599,156, issued to Samuel Wilnin and W. Teichner. The toy shown above is especially useful in teaching children how to spell. A device consisting of a man with a bell is moved past the letters until it strikes an arm which causes the bell to ring. The toy is placed in a box with a hinged lid.

EMERGENCY HEATER

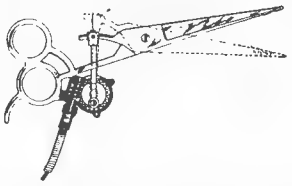
No. 1,611,881, issued to William Allen Brown. This heater consists of detachable heating and lighting



lamps which are protected by a shade. The heating unit is surrounded by vertical flues which allow the heat to be dissipated throughout the room. The heating and lighting bulbs are equipped with switches so that the device may give heat or light, or both. The heater is small and compact.

ELECTRIC BARBER'S SCISSORS

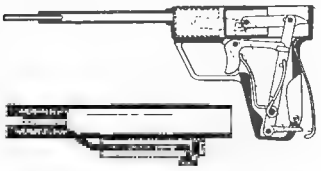
No. 1,614,379, issued to Umberto Miozza. This invention comprises a motor actuated scissors for barber's use in which the drive mechanism for one of the blades is supported in a casing on the handle of the second blade. Each blade has a finger grip so that the scis-



sors may be easily guided. One of the blades has a curved haft. The simplicity and advantages of this type of construction will doubtless be perfectly apparent to those skilled in the art of hair cutting. One side of the casing is closed by means of a cover plate. This plate may be removed so that repairs can be made upon the mechanism.

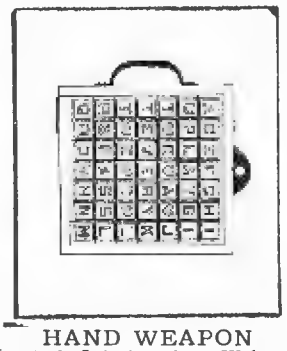
INSECT GUN

No. 1,611,533, issued to Walter Bruno Erwin Kirsten. This novel device consists of a small liquid-shot nozzle, and main barrel which contains the liquid. The inner walls of the barrel form an acute angle with the liquid-shot nozzle. The gun is economical in operation.



CROSSWORD-PUZZLE BLOCK

No. 1,604,127, issued to George Lambert. The object of this invention is to produce a set of lettered blocks in which the letters are arranged to form cross and lengthwise extending words when the blocks are positioned according to a given design or patent. Some of the surfaces of the blocks are provided with a letter and the remaining surfaces with an ornament.



HAND WEAPON

No. 1,598,784, issued to Walter S. Rae, Robert B. Reynolds and Victor Bailey. The hand weapon shown below provides an efficient means for emitting an incapacitating gas such as tear gas, sneeze gas, or the like. The weapon is constructed in a form of a policeman's mace, and has a trigger mechanism for setting the gas generator into action. By means of electricity a cartridge containing the poisonous gas is set off. The gas issues from the nozzle, continuing until the cartridge is expended.

NOTICE TO READERS. The above illustrated and described devices have recently been issued patent protection but are not as yet to our knowledge available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information as it is practically impossible to obtain up-to-date addresses. —EDITOR.

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4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculations, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

ANEMOMETER

(2170) Moses Warren, Lynn, Mass., asks:

Q. 1. Why are hemispheres used as vanes on an anemometer?

A. 1. The hemispheres used on the arms of an anemometer are constructed in that manner in order to obtain a stream line effect and also so that the pressure will be constant.

Q. 2. In a bismuth-antimony couple, which way should the current pass for a cold joint?

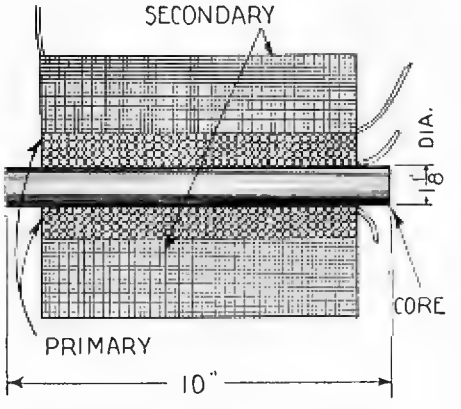
A. 2. In the Peltier cross composed of bismuth and antimony, the current should pass from the bismuth to the antimony element for a cold joint.

The effect of cold produced by a Peltier cross is very small and depends to quite a great extent upon the amperage used.

BUILDING AN INDUCTION COIL

(2171) Mr. I. Cohen, Toronto, Ont., asks:

Q. 1. Can you give me the necessary data for building an induction coil to give a 2" or 3" spark, stating the size of wire and other details?



INDUCTION COIL DESIGN

The constructional design of a 2" spark coil is shown in the diagram above. Q. 2171.

A. 1. A 2" spark coil may be assembled according to the following directions: Annealed soft iron wire, No. 22, is used for the core, the diameter of which is 1⅛" and the length 10". The primary coil consists of 200 turns of No. 14 double cotton-covered copper wire, wound in two layers. The secondary consists of 31 pounds of No. 38 double cotton-covered copper wire. The condenser used across the vibrator terminals should have a capacity of 1 mfd. A coil of this type works very well on 6 to 12 volts, the necessary current to be furnished by dry cells or by reducing the D.C. house current to a proper value. The primary and secondary are best separated by the use of Micarta or empire cloth, and the layers of the secondary may also be separated in this manner.

LIGHT FROM STARS

(2172) Mr. H. C. Long, Tishomingo, Miss., asks:

Q. 1. There is a certain star that is so far from the earth that it takes the light from this star 10 years to reach the earth. Should this star cease to shine tonight, would the people on this earth know it ten years from tonight or would they know it at once?

A. 1. Granted that the light ceased instantaneously, with no symptoms of a change which may be interpreted in advance of the phenomena, the people on the earth would have no indication that the star had ceased to emit light until the last wave had reached the earth, ten years after the extinction.

CLAYS

(2173) Mr. J. B. Barclay, Shanghai, asks:

Q. 1. Please give me a formula for a claying mixture for forges.

Q. 2. What is the formula for a plastic modeling clay similar to Plasticine?

A. 1. Claying Mixture for Forges.—Twenty parts fire clay; 20 parts cast-iron turnings; 1 part common salt; ½ part sal ammoniac; all by measure.

The materials should be thoroughly mixed dry and then wet down to the consistency of common mortar, constantly stirring the mass as the wetting proceeds. A rough mold shaped to fit the tuyere opening, a trowel, and a few minutes' time are all that are needed to complete the successful claying of the forge. This mixture dries hard and when glazed by the fire will last.

A. 2. Plastic Modeling Clay.—A permanently plastic clay can be obtained by first mixing potters clay with glycerine, turpentine, or similar bodies, and then adding vaseline or petroleum residue rich in vaseline. The proportion of clay to the vaseline varies according to the desired consistency of the product, the admixture of vaseline varying from 10 to 50 per cent. It is obvious that the hardness of the material decreases with the amount of vaseline. By the use of various varieties of clay and the suitable choice of admixtures, the plasticity, as well as the color of the mass, may be varied.

TREATING ELECTRICAL BURNS

(2174) Mr. O. E. Bergstrom, Roseau, Minn., writes:

Q. 1. I am enclosing several queries regarding the treatment of electric burns which I wish you would answer for me.

A. 1. We have referred your various queries regarding the treatment of burns to our Staff Medical Expert, and his composite reply is given below.

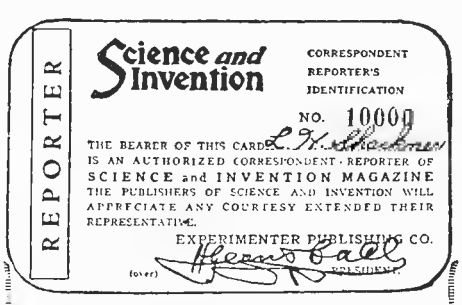
"The burn you have described is evidently a second to a third class burn and the best method of treatment is in the application of picric acid. This is slightly antiseptic and allays the pain incident to all of these types of burns.

Lately, medical men have had a great deal of success in excising the necrotic areas and then resorting to skin graft when necessary, although this was only required in a few cases as the healing took place very readily after the necrotic tissue had been removed.

There is no reason why a Dakin irrigation would not be effective, but it surely would be no better than the old method of using soap and water or boracic acid.

There is always a danger of infection from a severe burn and a great danger of auto-intoxication. This, however, should be over in five to six days but has occasionally persisted for twice this period. A prompt epidermization prevents absorption of a toxic substance formed during the injury. An injection of digalen can be used and coffee or other stimulants given. Water should be drunk freely to aid elimination. Morphine is occasionally given, but in cases of shock care must be taken that the blood pressure is not further lowered. The main idea in preventing pain is to exclude air from the burn. This, of course, means that dry dusting powders or oils are generally placed over the area of the wound. At the same time, excluding the air interferes greatly with the plans of management in accordance with antiseptic precautions. We believe that picric acid dressings would be superior to a Dakin solution.

For superficial burns use a bandage or pad of eight or ten thicknesses of muslin, saturated with olive oil.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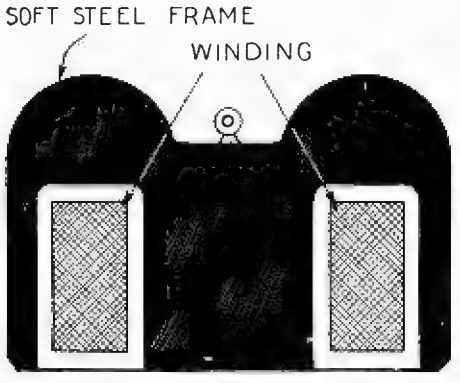

SECTIONAL VIEW OF LIFTING MAGNET

A sectional view of the portative or lifting magnet is shown in the above illustration. Q. 2177.

CALCULATING CENTRIFUGAL FORCE

(2175) Mr. Nick Davlantes, Chicago, Ill., writes:

Q. 1. Please indicate for me the formula for finding centrifugal force.

A. 1. We are giving you below the formula necessary for the calculation of centrifugal force.

$$V = \frac{2\pi RN}{60}; \quad F = \frac{Wv^2}{gR}$$

In the formula, R the radius of the curved path in feet, F the centrifugal force exerted upon the arm or cord connecting the body with the shaft, W the weight of the body in pounds, N the number of revolutions per minute, V linear velocity of the center of gravity of the body in feet per second, G 32.174.

IMITATION NUGGETS

(2176) Q. 1. Mr. Cohick, Olive View, Calif., sends us a metallic nugget and ask how to produce such in imitation of gold.

A. 1. We believe that the imitation gold nugget that you submitted to us is made of brass. Probably it is made into the form that it takes by dropping the molten metal into loose sand or earth. If the metal tends to spread over too great a surface, make small, irregular indentations in the surface and pour the molten material into them.

LIFTING MAGNETS

(2177) Mr. G. C. Lutes, Rushville, Ind., writes:

Q. 1. I have both AC and DC available, but I am anxious to obtain information on an AC lifting magnet. Can you furnish me with this?

A. 1. There has been no development in AC magnets which corresponds to the DC lifting magnet, and about the only good example of an AC holding magnet is the no-voltage release on circuit breakers, oil switches, and motor starters. As the lifting power depends upon the square of the flux density, soft steel is usually used for the frame because of its permeability, in cast form for D.C., and laminated for A.C. A powerful lifting magnet might have the following dimensions: The diameter of the inner pole is approximately 7". 7,304 turns of No. 28 enamel wire are wound on the pole. This coil of wire should be 2 2/10" long and 1" thick. The outer pole is made to encase the inner, and also encloses the coil. The coils in the portative magnet are entirely enclosed, and the heat must be transmitted through the iron before it can be radiated. For this reason the coils are not rated the same as those which are exposed to the air.

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With a bunch of these bills, it is easy for each person of limited means to appear prosperous by flashing a roll of these bills at the proper time and peeling off a genuine bill or two from the outside of the roll, the effect created will be found to be all that can be desired. **Prices, postpaid: 40 Bills 20c, 120 for 50c, or $3.50 thousand postpaid.**

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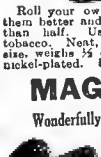

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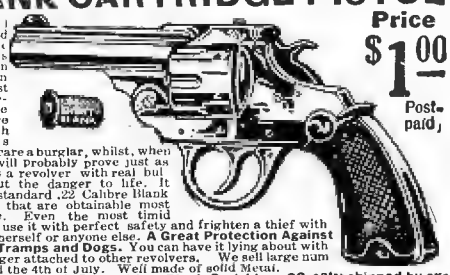

This well made and effective Pistol is modelled on the pattern of the latest type of Revolver, the appearance of which alone is enough to scare a burglar, whilst, when loaded, it will probably prove just as effective as a revolver with real bullets, without the danger to life. It takes the standard .22 Calibre Blank Cartridges, that are obtainable most everywhere. Even the most timid women can use it with perfect safety and frighten a thief without risk to herself or anyone else. **A Great Protection Against Burglars, Tramps and Dogs.** You can have it lying about without the danger attached to other revolvers. We sell large numbers around the 4th of July. Well made of solid Metal. **PRICE ONLY $1.00 Postpaid. Blank Cartridges 22-cal. shipped by express only, 50c per 100. Johnson Smith & Co., Dept. 713 Racine, Wis.**

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Mystic Skeleton

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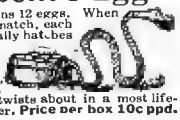
A jointed figure of a skeleton 14 in. in height, will dance to music and perform various gyrations and movements while the operator may be some distance from it.

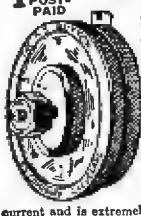
Serpent's Eggs



Box contains 12 eggs. When lit with a match, each one gradually hatches itself into a snake several feet long, which curls and twists about in a most lifelike manner. **Price per box 10c ppd.**

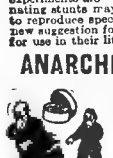
Microphone Transmitter Button

$1.00 POST-PAID



You can easily make a highly sensitive detectophone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in micro-phones. You can mount the button almost anywhere—card board boxes, stove pipes, stiff calendars, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen in on conversations in another room. A deaf person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Button may be used to renew telephone transmitters; often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplifies radio signals. Countless other similar uses will suggest themselves. Experimenters find the Button useful for hundreds of experiments also—the lines of telephones, amplifiers, loud speakers, etc. Many fascinating stunts may be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. $5.00 is given to anyone who sends in a new suggestion for the use of the Button providing the manufacturers find it suitable for use in their literature. **PRICE $1.00 POSTPAID ANYWHERE.**

ANARCHIST BOMBS



One of these glass vials dropped in a room full of people will cause more consternation than a limburger cheese. The smell entirely disappears in a short time. **10c a Box, 3 Boxes for 25c**

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ITCHING POWDER

This is another good practical joke; the intense discomfiture of your victims to everyone but themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the powder can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more.

10c box, **3** boxes for **25c** or **75c** per doz boxes

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The Wonders of Our Nervous System

(*Continued from page* 113)

there the corresponding imprints. As long as it moves about over other parts, it seems to have vanished, to be confused; but as soon as its own image is encountered, it shines up both clear and sharp as a "memory image." We recognize the image as already seen in the past, as something known, as a key and switch it off automatically to another neuron into that center where we are accustomed to send an object after we recognize it. This is the center of speech.

Speech is our principal, almost exclusive means of expression, and twice in our lives we learn how to speak. The first time as children it is purely optical and acoustic, while we imitate grown-up people; and react to the sight of special objects with special sounds. They will say that is called a key, and we imitate the sound of the word key; the second time we learn to speak is when we learn to read and to write. Then we find out that not only the object picture of a key is called "key," but that there is also a *letter picture* of a key. This letter picture for the later life of man is at least as important as the object picture, and indeed for the intellectual man far more important. The intellectual man experiences much more through the letter image than through the object image of the world. We all know Africa, India, Japan and the Polar ice. We know almost perfectly ancient Egypt, Rome, the Trojan War, the Crusades, and the discovery of America, and would know at once where we were, if we were transported into one of these epochs, all through letter pictures that we have absorbed by reading.

The letter pictures are impressed on a special part of the brain, on the memory field for word pictures (5). Through years of daily exercise and habit to develop memory pictures through word pictures, the connections between both centers are so numerous and so thickly traveled, that we can no longer see the image of a key without at once consciously or unconsciously seeing the word picture "key," and the reverse sense cannot read the word key anywhere, without at the same instant finding in our memory the object image of a key.

In the case of every common word this reproduction of the word itself no more impresses itself on the consciousness than does the hardness of street pavement as we walk. All familiar objects operate automatically and unconsciously. If we look upon words more or less difficult and seldom used, such as for instance Fujiyama, we will perceive that in speaking this name we not only will picture to ourselves a snow-covered smoking mountain, but also the letter image, Fujiyama. And the same is the case if we express Tut-ankh-Amen. If we utter such a word we set into motion the speaking muscles in the line of letters "sweeping before us" through a new nerve region, the motor speech center (6). In the case of common words we are no more conscious of this mechanism than is the pianist of his finger play in a piece of music which he is performing, but as children we learn laboriously to speak, and later we learn to read and write, to play the piano or use the typewriter, and we learn a foreign language; thus we can clearly, by reading a text, follow the not rather difficult shifting of the nerve current from the optical speech center to the motor speech center.

This motor center discovered by the French scientist Broca, and known under the name of "Broca's center," can be compared to the keyboard of a piano or also to that of an electric piano. By the switching of certain wire conductors, nerves (7), this keyboard sets into motion the different parts of the speech apparatus in the larynx (8), the muscles, ligaments and mucous membrane of the larynx, the diaphragm, ribs, neck and mouth muscles, or else holds them in position and so creates the involved mechanical requirement of the enunciation of single syllables.

It is not necessary to emphasize the fact that we are using analogies here for the three technical images, the reflex action of the knee tendon, skin sensitiveness, the seeing and speaking act, that we are using visual comparisons by which we picture to ourselves unknown and, therefore, unintelligible processes, so as to picture them clearly. But the great analogy of the nerve system which, omitting details, and taken as a whole, it possesses with the electrical apparatus of our technique, makes such comparisons appear justified if the reader at the beginning as well as at the end of this presentation realizes we do not know with certainty the true nature of nerve excitation. Consequently the bio-technical sense of the individual parts have to give expression to what we know in the state of our present information, which is open to change and not yet fixed and definite.—*Kosmos.*

Articles In June "Radio News"

Radio Guides the Battle Fleet,
By Lieut. H. F. Breckel

Television in Darkness, By A. Dinsdale

Radio Television Demonstrated in America, By H. Winfield Secor

Easy Construction for the "Ham."
By John L. Reinartz

New Power Pack and Power Amplifier,
. By McMurdo Silver

The DeLuxe System of Reception,
By Arthur H. Lynch

The Interbalanced Regenerative Receiver

The Transoceanic Telephone Interflex

The Jewell Adapter Unit

The New Raytheon "A-B-C" Power Unit

What Tuning Really Does Electrically

Radio Wrinkles Wanted!

The Radio Editor, Mr. Paul E. Welker, wants to hear from you, if you have a good idea or wrinkle. Make a pencil or pen and ink sketch of the contrivance, write 50 words or so of description, and mail to the Radio Editor, c/o this magazine.

CREDIT NOTICE

The article entitled "Distant Hot-Water Control" appearing on page 23 of the May number, should have contained credit to the Timeostat Corporation for the illustrations.

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Edited By
Joseph H. Kraus

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Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.

DEFRAUDED

(1021) John T. Bold, Springfield, Ohio, writes: as a reader of your publication may I ask for timely informative advice about ideas, discoveries or inventions, basically principled and patentable? Several are very simple, easily made, but give results far beyond expectation. Some of my friends had excellent patents which were marketable and might have been profitable to both manufacturer and inventor, but the patentees were completely manipulated out of their profits by the manufacturers.

I have never disclosed any of my discoveries for this very reason; therefore, would like to know if I can prevent being defrauded. My inventions are in the line of airplanes and helio-dynamics.

A. If any of your friends were defrauded of any profits then that fraud was perpetrated with the patentee's thorough sanction and approval. You must remember that when you patent an article you have the right to manufacture that article and you can bring suit against anyone who may infringe upon the idea. If you assign your entire rights to an organization for a small sum of money, then you have knowingly done so and there is no fraud there. If the particular articles subsequently prove to be very valuable, you have no redress whatsoever and the value is not dependent upon your efforts, but upon the efforts of the manufacturer and his sales force.

PERPETUAL MOTION

(1022) A. A. Munsey, Paden, Okla., writes: I would like to have some more information about a perpetual motion device. I have tried it out and it proves to be successful. Do you think that it would pay to get a patent on it? Being unable to carry it out as I would like to, will you please tell me what to do about it? Or could you give me the names of men who would be interested in a machine of this nature? People say it is impossible to make it, but if enough money is offered it will be presented at once.

A. Science and Invention Magazine has a standing offer of $5,000.00 which it will pay to the individual exhibiting at its offices any type of a perpetual motion machine. By perpetual motion we refer first to a machine, not to electronic movements or molecular movements in a body. Secondly, the machine must not operate by either atmospheric temperature changes, atmospheric humidity changes, atmospheric pressure changes, water falls, tides, winds, waves or evaporation. This would seem to indicate that the mechanism should be of such a nature that its power is either self-contained or an article that will work by gravity or buoyancy. It is obvious that the factors above enumerated are forces which are constantly variable. There are many conditions where machines would not operate as, for instance, a device operable by wind, tides, waves, or water falls could not be placed into a building and be expected to furnish power.

Before anyone can get a patent on a perpetual motion machine, it is absolutely essential that a working model be submitted to the patent office. If the working model is submitted to Science and Invention Magazine first, before the news of its discovery becomes universal, the successful inventor will be awarded the prize.

BICYCLE LOCK

(1023) E. A. Mack, Tulsa, Okla., submits a sketch for a lock for bicycle handle bars and asks whether we think the idea patentable and whether it would pay him to patent the same.

A. We certainly do not believe that a handle bar lock of the nature described by you is of any practical value. A bicycle with a handle bar lock on it as indicated can be stolen just as easily as if it had no lock at all. If an individual would take the trouble to tow this bicycle away or even coast away with it for a distance of one or two city blocks, he would be able to remove the lock in peace by the dexterous use of a file, a pair of clippers or anything else required. Loosening up on the nut at the front of the handle bar which clamps the handle bar in place would also permit the thief to shift the handle bar far enough to one side to permit of reasonable steering qualities. We do not advocate applying for a patent on an article of this nature.

ANT SHIELD

(1024) Albert McDowell, Los Angeles, Calif., submits an idea for an ant shield for tables and cupboards which consists of a suitable receptacle adapted to fit the roller-caster on chairs, tables and the like and so arranged that it can contain poison. He would like to know whether the same is patentable and also if publication in a magazine helps one or prevents one from getting a patent.

A. We do not think very much of your suggestion for the prevention of ants and cockroaches from reaching table-tops and chairs for the simple reason that both of these insects, and particularly the cockroach, can find its way to the table-top via the walls. The accidental spilling of the poisonous liquid over the floor is a possibility and the theoretical advantages of the article are negligible in comparison with the expense and relative efficiency.

Publication in a magazine sometimes may assist in the securing of a patent because it establishes a claim of priority. On the other hand, patents in certain foreign countries are rendered impossible by such publication. On the whole, publication assists in the getting of patents and does not act as any serious detriment. Publication must not precede application more than two years, otherwise it invalidates the application.

VACUUM BOTTLE LIQUID DISPENSER

(1025) William Gregson, Ft. Worth, Texas, submits a suggestion for a vacuum bottle similar to the thermos bottle provided with a cup top and also with a pump permitting the contents of the thermos bottle to be pumped out rather than poured out as in modern styles. He requests our advice.

A. We are of the opinion that a pump for lifting the contents of a thermos bottle makes the article entirely too expensive to warrant its being patented. The advantages of such a pump system are questionable. Except in the case of very large bottles, which are tipped only with difficulty, such a pump is a detriment rather than an improvement on a thermos bottle because the heat of the liquid in the bottle is communicated to the cylinder of the pump and then disseminated in the air. In an article of this type the general tendency would be for the liquid to cool much quicker or to lose its low temperature much more rapidly than if a cork were placed in the mouth of the bottle. It

(Continued on page 166)

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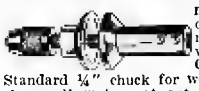

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being just as easy to tip the bottle as it is to operate the pump, and it being a much easier task to clean a bottle without a pump than it is to clean one equipped with some such contrivance, we would advocate against applying for a patent on the same.

SHAVING BRUSH AND CALIPER

(1026) James Daniels, Baltimore, Md., submits two suggestions, the first is a caliper meter for inside and outside measurement of pipe and the second is a folding combination shaving brush and soap case. He asks our opinion on both articles.

A. The suggestion for a combination shaving brush and soap case advanced by you is not new. It possesses several features which make it a little better than other articles on the market, the most important one of which is the rectangular shape of the brush and the soap container. Inasmuch as modern brushes are made in round form and shaving soaps are also made in this same shape, and further because the bristles of a brush preserve their shape better when a brush is round than when rectangular, it is doubtful if a patent on your suggestion would be of financial value.

The caliper meter which you have designed is neither new nor accurate and we would certainly not advocate applying for a patent on the same. The only advantage in either of your two ideas lies in the rectangular handle for the shaving brush, which is not a patentable subject.

How a Famous Phonograph was Invented

By W. H. JENKINS

(*Continued from page* 115)

The year 1925 was one of the most trying periods through which the talking machine industry had passed since its early struggles for recognition. In striking contrast, however, was 1926, which proved to be one of the largest years, in both volume of production and profits, in the history of the company. Scientific research and invention, combined with modern marketing methods, had brought about this complete and sweeping reversal of conditions.

But research has not lagged for a moment. Recently there was announced the development of a super-talking machine, the Auditorium Orthophonic talking machine, which reproduces the complete range of musical sound, and can be heard clearly half a mile away when operating at full volume. And there are other inventions in the laboratory which are expected to provide further surprise in the industry.—*Photos courtesy Victor Talking Machine Co.*

The Astrology Humbug

By JOSEPH H. KRAUS

(*Continued from page* 137)

Good astrologers do not predict deaths, they only indicate tendencies and advise their clients to be careful when certain adverse tendencies are indicated, and to act with confidence when the tendencies are favorable. The astrological chart is as necessary for a safe journey through life as is the mariner's chart to a captain, or railroad signals to a locomotive driver. Astrology does not play on people's fears or make guesses by the law of averages; on the contrary, it gives people confidence by advising action or caution along intelligent lines. In short, it develops self-reliance and the mental powers so as to get the greatest happiness out of life.

If your articles were less abusive and more logically critical, they would be more effective.

G. A. Field, B. A., Christ's College, Cambridge University; Barrister-at-law of the Inner Temple, Montreal, Canada.

(Before proceeding further let us compliment you on your communication. You have written a splendid letter. You have pointed out just where astrology begins and just exactly where it ends. But it seems that astrologers as a whole have confidence in their ability to forecast events and to prognosticate far beyond the limitations set by you. Frankly, we do not believe an individual needs an astrological chart in order to "develop self-reliance or the mental powers so as to get the greatest good and happiness out of life." We are of the opinion that a person can develop the same characteristics without an astrological chart, the majority of which fall far short of the mark. If astrologers are only capable of indicating tendencies, then it is obvious that they could not possibly meet with the conditions outlined in our contest. Inasmuch as your letter has not raised very many questions in our minds, we cannot comment more freely on this—Editor.

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Making Steel Auto Bodies

By H. W. TOWNSEND

(*Continued from page* 114)

course, the majority of the body builders are using a thin paint which can be sprayed on, and also, thanks to this new process of finishing car bodies, the time element is vastly reduced. Thus the bodies can be painted while moving along on a continuous platform.

As the pictures show, the various parts of the body, such as mudguards, door sections, engine bonnets, et cetera, are first punched out by means of large punch presses and dies, these individual sections then being electrically spot-welded together.

The next step comes when these different sections of the body are all lined up side by side in a large assembly frame or jig, as one of the pictures herewith shows. When the body sections have all been clamped together into position, the essential joints between the sections are joined by either riveting, gas or electric spot-welding. Aside from some finishing touches, with the aid of electric arc or oxy-acetylene welding, and a few rivets perchance, the entire metal body has been assembled at the push of a button, so to speak. Any rough seams or joints are dressed down when necessary by means of a fine emery wheel mounted on the end of a flexible motor-driven shaft.

Next the bodies are inspected for mechanical strength and then the finishers go over them rapidly with emery paper and other finishing materials preparatory to painting. Forty-five minutes are required for the completion of all operations to get the body ready for the desired finish. The upholstery which has been prepared on the bench simultaneously with the other operations is then applied on the conveyor, and the body is ready to be attached to the chassis.

—Photos courtesy Edward G. Budd Mfg. Co.

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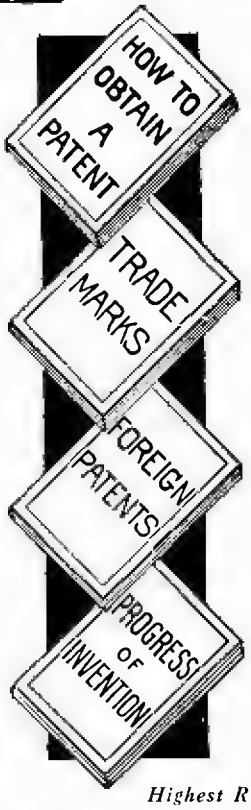

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Answers to Scientific Puzzles

(*Continued from page* 135)

THE SPEED COP'S SPEED

THE motorist traveled ½ mi. at 60 miles per hour according to the testimony of the officer. Hence he was overtaken in ½ min. But during the same interval the officer went ¾ mi. or $\frac{3}{4} \times 2 \times 60$, which equals 90 mi. per hour.

THE SIPHON

A siphon operates because of an unbalancing pressure per unit area produced by the difference in vertical components of length of the liquid columns in the two arms. The atmospheric pressure is practically the same at the levels A and C, but the liquid pressure is different. BC produces a greater pressure downward than does the column AB because of the greater length of BC. (Pressure or force per unit area is proportional to the depth of the liquid column and is independent of the size or shape of containing vessel.) As the liquid runs out of the tube BC the pressure is reduced at A to less than atmospheric and more water is forced in to take its place. Thus the siphon will work in spite of the fact that there is a greater weight of water in the short arm.

THE HEATING COIL

A heating coil should not be placed above the upper connection A, where it joins the reservoir, for in that case the water in the pipe between A and B, will be exactly balanced by a similar column of water within the reservoir and no circulation will be set up. If the heating coil is between A and B, the heat will cause the water in this part of the pipe to expand, become lighter than the corresponding column of water in the tank and hence a current of water will be started, which will continue as long as the water in the tank is cooler than the water in the coil.

HILL CLIMBING

The per cent of grade is figured by the ratio of the rise of the grade for each hundred feet of length measured horizontally. The grade represented in the diagram is 200/1000 or 20%. As a grade of 5% is seldom encountered on a really good road and even mountain highways such as the one up Pike's Peak do not run over 12% it will be seen that this is an excessively steep grade.

THE COLD FRAME

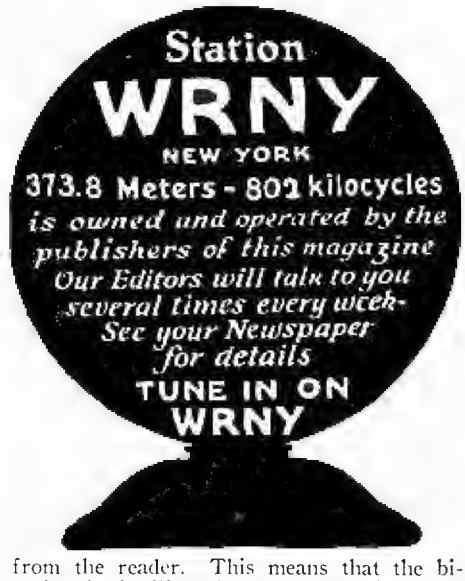
While the sun is shining on the surface of the earth the latter is continually absorbing heat in the form of radiant energy and reradiating it back into space. The length of the waves that strike the earth are much shorter than those that are radiated away, for those from the sun come from a very hot body, while those from the earth come from a relatively cold body. A pane of glass such as is used in a cold frame has the curious property of transmitting short waves more readily than long ones. Hence it acts as a trap for the heat from the sun and permits more energy to enter than it permits to escape. The temperature inside the frame then rises until the excess of heat is lost by conduction through the walls and radiation also.

A PULLEY PROBLEM

The 240 pound load is evidently distributed between the five supporting ropes A, B, C, D, and E. If the tension in A be represented by X it is evident that the tension in ropes B, E, and D must also be X since they are different segments of the same rope, whereas the tension in rope C must be 2X since it supports the block that holds ropes A and B. The sum of the tensions in the five ropes is 6X, which equals 240 lbs. Therefore, X equals 40 lbs., the force with which the man must pull on rope A.

THE BICYCLE WHEEL

This problem is similar to that involving the precession or wobbling motion of a top. The rule for such precession is stated in terms of three axes at right angles to each other: the spin axis, the torque axis and the precession axis. The arrow heads on the axle of the wheel indicate the direction of the spin axis. If one looks in this direction the wheel is seen turning clockwise. The torque axis is perpendicular to the table and its direction is downward since if one looks in this direction the table appears to be turning clockwise. The precession axis or the one about which the wheel will tend to turn is at right angles to both the other axes and its direction is determined by the following rule: Extend the thumb, forefinger, and middle finger of the right hand at right angles to each other with the forefinger pointing in the direction of the spin axis and with the middle finger in the direction of the precession axis. The thumb will then point in the direction of the precession axis. Following this rule, developed from the laws of physics, it will be seen that the precession axis in the figure should be perpendicular to the paper and directed away from the reader. This means that the bicycle wheel will tend to turn clockwise about this axis and thus bear more heavily upon the B scale and less heavily upon the A scale.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SHOT FIRED VERTICALLY

In analyzing this problem let us first consider what would happen if there were no air or atmosphere to disturb the flight of the bullet. As the bullet leaves the gun it has the same eastward velocity as that of the surface of the earth from which it is fired. By Newton's first law of motion we know it will tend to maintain this same velocity after it leaves the gun. Gravity will, of course, affect its motion vertically, but will have nothing to do with its eastward drift. Assuming then that its eastward drift remains unaltered, it is evident that it cannot keep up with the rotation of the earth since the surface of the earth is moving through a smaller circle than is the bullet, which is far above the earth's surface during a part of its flight. Consequently it will fall west of the spot whence it was projected.

The effect of an atmosphere would be to increase the eastward drift during the ascent and then to slow it down during the descent, but at no time would it decrease it to less than what it had originally. Thus a shot fired through air would not fall so far west as if fired through a vacuum.

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Freak Plants and How they are Produced

By DR. ERNEST BADE

(*Continued from page 116*)

the experiments of a gardener. By chance a fruit-bearing mountain ash was found by a shepherd. Twigs were taken from this tree, and grafted upon a European mountain ash or rowan tree so that today this fruit tree is not so rare. Also the "Marmake," a fruit tree half apricot and half plum, but larger than the former and more tasty than the latter, has arisen during the last two decenials, but when or where is not exactly known.

We must thank an Indian of South America for our seedless oranges. He showed this tree, growing in the jungle, to a missionary who, after many hardships, brought some twigs back to civilization. These were grafted on an ordinary orange tree, but today this is carried out with seedlings with the result that these trees will bear oranges without seeds.

Thin, many branched cacti are often grafted on thick varieties in order to develop a plant which will produce flowers at different times, and also to improve and make them flower more prolificly. But more often this method is resorted to to make odd looking plants, for instance a slender cactus grafted upon a spherical species. *Echinopsis multiplex* produces a comb which is developed by grafting.

In general, grafting and budding is only possible when the stock and the scion are closely related or belong to the same genus. Here the wood and the bark tissues are analogous in character. Unions of unrelated plants often exist for a time, and seldom, indeed, are they permanent. For the tissues of wood and bark rarely grow together, but when they do, such unions are always extremely interesting.

The Japanese dwarfed plants are examples of the gardeners' skill. Their care depends upon an excessive and oft repeated pruning, providing a meager type of soil, and cultivating in tiny vessels. They are typical hunger forms, deformed plants, suffering all the maltreatment which the gardeners' ingenuity can devise in order to retard their growth. A meager supply of water, continual pruning, a twisting and distorting of twigs, and a decrease in the nutritive salts of the soil are the primary factors involved in their production. The gardener gives them no more than is absolutely essential for life. They can neither thrive nor die.

Many flowers, and especially the gayly colored water-lilies have the inherent property of closing during the night, and others during the day. This greatly detracts from their value as a cut flower. In order to keep such flowers open after they have attained their full beauty, they are placed up to their calix in water containing a substance which paralyzes the plant organism. By this means the calyx and the corolla is made immovable with out changing the appearance of the flower in the least. This method will be most successful with those flowers which have been open one or two days. Substances such as alum, borax, potassium chlorate, or alcohol, act in this manner. Salts of the metals also paralyze the tissues of the plant when dissolved in water. A drop of such a liquid injected near the calyx with the aid of a syringe will give the desired result.

The ancient methods of changing the snow-ball flower to a deep reddish blue is now universally known by florists. This desired effect is obtained by giving the plant a soil rich in iron or by watering it daily with alum water (1/13 of an oz. to a pint of water.) It is also possible to give

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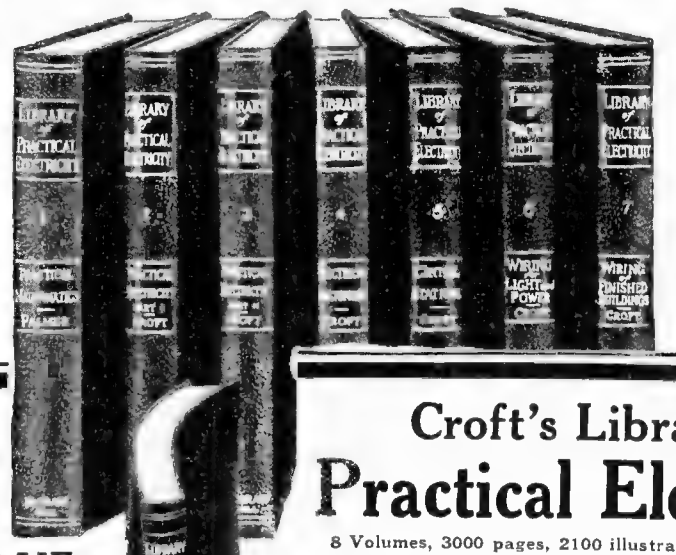

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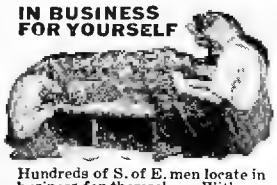

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the white snow-ball any desired color after it has been cut. Simply add an aniline color to water, make a hole the entire length of the stem with a long needle and place the flower in the solution.

A peculiar floral coloration takes place when *Myrtus communis,* having tiny green buds, is placed next to a flowering oleander so that the flower twigs hang above the other plant. *Myrtus communis* will then generally produce pink flowers. Why this should occur has not, as yet, been satisfactorily explained.

It is well known that plants can be awakened from their winter's rest and made to grow and flower. The first attempts along these lines were a removal of the retarding influence of winter and substituting more favorable conditions for growth. This method was successful with some plants, with others it was a distinct failure. It was shown that in many species the resting period is a necessity so that other methods of procedure had to be devised. In many cases such experiments were successful, and many are the ways in which the desired results can be obtained. Especially valuable in this respect are the ether and hot water baths.

Etherization is carried out by placing the plant in an atmosphere saturated with ether, and letting the plant remain here for 48 hours. Then it is immediately removed to the hot house. A peculiar feature of this method is the fact that the plant will not only develop normal leaves and flowers, but that they are produced much quicker than under ordinary conditions.

Can We Fly to the Planets?

(*Continued on page* 104)

tor, Herman Ganswindt, claimed to be the first constructor of a cosmic ship, because in the "eighties" of the nineteenth century he had treated of the practicability of rocket ships. Next from Vienna came the news that Dr. Franz von Hoefft had been interested in rocket ships, and in Linz, engineer Franz von Ulinski, about 1900, had constructed a spherical cosmic ship to be driven on the rocket principle and later proposed a sun engine which would use sun power directly for driving his machine. In Switzerland engineer A. Dittli claimed that he had solved the problem of cosmic flight theoretically but he could not consent to disclose the smallest feature relating to the construction of his machine. In Paris the constructor Seargent was irritated not a little, because others claimed to come before him, while he for a long time had busied himself with the reaching the moon. Finally in Russia, Prof. Ziollowski appeared very active in this line. He was a scientist of reputation, who as long ago as 1898 had published a paper on this topic.

In the year just passed, two new plans for the conquest of cosmic space were published. One of Dr. Franz von Hoefft, who in Vienna had established a society for investigating cosmic space, combined Goddard's ideas with the Oberth rocket with liquid propelling material, and wanted to send a flash light greeting to the moon with this. To be sure, the first thing is the construction of an exploring rocket whose registering apparatus weighing from one to three kilograms (2¼-4½ lbs.) is only to go 100 kilometers high—62 miles. If this experiment succeeds this small proof-rocket which of course carries no body, will be made of greater size so as to reach an altitude of 250 kilometers or more—155 miles, so that it would enter the region of empty space where there is no atmosphere. It is fair to say that nobody as yet in Vienna is troubling their heads

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with the idea that a further increase in size of this model is impending until it could carry several hundred kilograms, and then rise several thousand kilometers, so that eventually it could carry up human beings. The other plan is due to Max Volier, of Munich, Germany. His idea is to start with the flying machines of today, to be developed into the future cosmic ship; quite the reverse of the Viennese plan, so that the regular airplanes will be used and by the introduction of stronger and stronger rockets, will gradually develop into rocket ships, which will give the constructor and pilot a chance to constantly watch the rocket motor during the flight.

For example, starting with a modern metal airplane, with regular wings and making of it a small two-seater, the first thing will be to replace the existing propeller motors by equally powerful rockets. The operations of a pilot will be unchanged by this.

The number of the rockets built into the wings will be constantly increased and their power will be made greater, so that the auxiliary propeller will be diminished in size as the experiments go on and its wing area will be diminished. As soon as sufficient experience and security in the action and the regulating of the rockets have been obtained, the time will approach to go over into an absolute rocket-plane with a hermetically closed body, with artificial heating and air supply, which will have no more driving machines or wings. The collection of rockets will be as it were bunched together to the right and left of the under side of the wings.

Such a machine would start very suddenly from a starting tower or from smooth water, just like fireworks rockets, so that naturally its mass would retard too sudden starting to keep it within the power of endurance of the crew. The landing of our hydro-airplane would follow the same lines, so that the ship with its front vertically upward would have a braking effect produced by low-power discharge of the rockets, and the pilot with his control could let the machine come softly to earth. For extreme cases a parachute can be built in, which would take the crew in a rescue chamber out of the open end of the ship and let them settle slowly to earth, while the machine itself might be precipitated down with destructive force.

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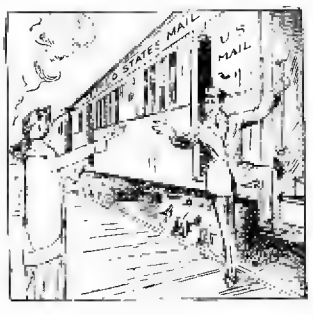

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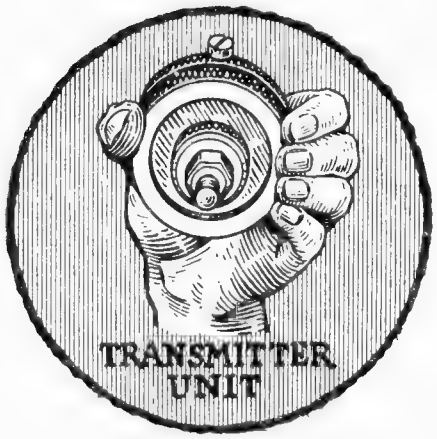

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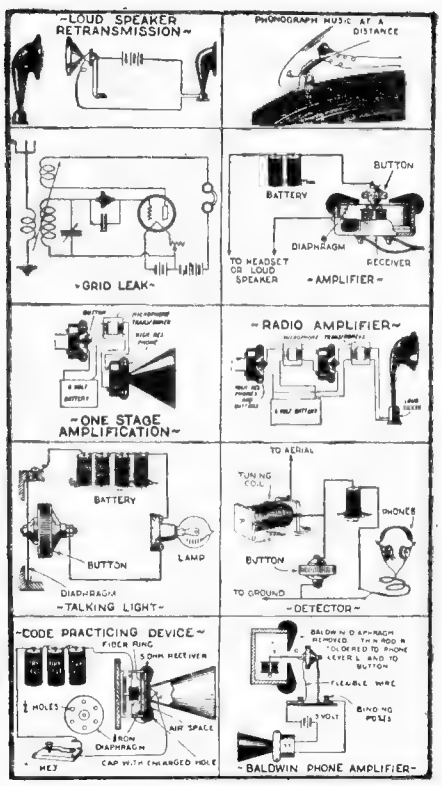

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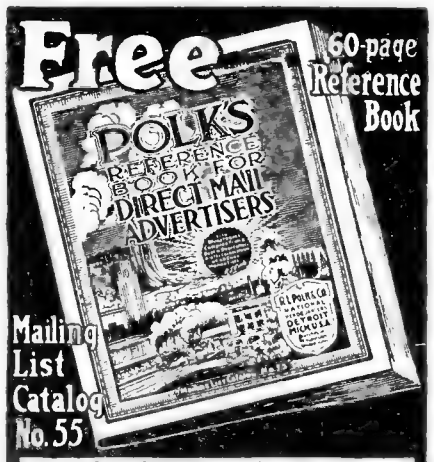
If greater horizontal distances are to be achieved, one must have recourse to a propeller again, which has a very favorable ratio of driving power to resistance, and would carry the ship at about 50 kilometers (31 miles) elevation with its full terminal velocity of 2,000 meters (6,500 feet) per second over a curve representing an elevated track developed from the original starting lines. One can then go down to an energy relation of one to eight in volplaning and in this way can cover two thousand kilometers (1,240 miles), in 1,500 seconds in slow descent, gradually expending, as it were, the height and initial velocity.

Undoubtedly the first kind of vertical ascent would, from the standpoint of science, be of greater importance, while from the viewpoint of transoceanic aerial travel, the horizontal flights would have the greater economic importance. In any case, a rocket flight over two thousand kilometers (1,240 miles) at 2,000 meters (6,500 feet) per second due to velocity of expulsion, would require ten tons of driving material per ton of paying load, while an ordinary flight with a propeller motor over the same stretch would only need two-thirds of a ton of gasoline per ton of paying load. To do this eight hours time of flight would be required, while the rocket would cover the same range in less than half an hour. The rocket trip costs in round numbers



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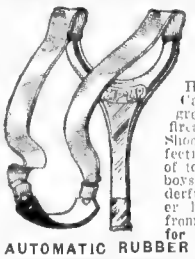

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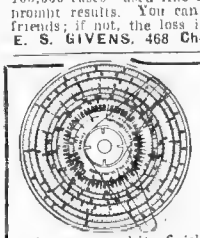

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There is no doubt whatever that today from a theoretical standpoint, we can clearly see the way, that is to say we know the formula for calculating the necessary driving power that the ship must be given to be driven clear of the earth (about 12,500 meters (40,000 feet) per second) for reaching the moon, and to rise again from this (about 2,400 meters (7,800 feet) per second) so as to come back to the earth, and retard the final descent upon its surface.

We already know of explosion materials, which have so high an energy content that their development would theoretically be sufficient to take care of a trip to the moon and return therefrom.

We are mostly concerned with the carrying of a sufficient quantity of this same explosive, and the question of using it with the highest degree of efficiency. We give the idea of the difficulties compared with today's airplaning. In the latter for the longest flights at least the weight of gasoline in the machine at starting with its full load will be at least 40% of said weight, whose explosion develops in the cylinders of the motors with about 25 atmospheres maximum pressure and 1,200 degrees maximum temperature. On the other hand, the above named rocket ship that only rises to 250 kilometers (155 miles) and flies 2,000 kilometers (1,250 miles) contains two-thirds, or more accurately 69 per cent of the entire weight in driving material. The ship develops 2,500 meters (8,000 feet) per second expulsion velocity, with an explosion temperature of 1,800 degrees, and at least 60 atmospheres of pressure. But if such a ship with the same (weak) explosive gets to the moon it must carry at least 99.3 per cent of driving material, leaving only .7 of one per cent for its load, because the theoretical relation of starting weight to end weight is 148.4:1. On the other hand this technically impossible weight relation can be materially improved if we had a more violent explosive to develop 5,000 meters per second expulsion velocity, which would give us then an initial temperature of 3,000 degrees and a pressure of several hundred atmospheres. With such driving material we need only 87.1% of the starting weight in driving material, leaving 12.9% to the constructor for the weight of the machine when empty, and one-fifth of the same, that is 2.5% of the initial weight, we can put aside for the useful load. Even in this favorable condition 35 tons of driving material would be required to carry one ton of useful load barely to the height of the moon (leaving out of consideration the landing on the same). For an expulsion velocity less than 4,000 meters (12,800 feet) per second, in an extreme case less than 3,500 meters (1,600 feet) per second, it follows from the preceding calculations, that so unfavorable a relation obtains between the weight of driving material and the weight of the unloaded machine, that no useful load can be considered possible.

As long therefore, as we do not reach the expulsion velocity of at least 4,000 meters (12,800 feet) per second and can use it in a large machine for six to eight minutes practically speaking, without blowing the whole ship to pieces by the frightful explosive power, even then the surface of the moon would remain a virgin land. On the other hand it appears quite possible that in a few years we can travel in the higher regions of our earth's atmosphere and attain a speed there of 10,000 kilometers (6,200 miles) per hour. Thus the time of travel from Berlin to New York could be reduced gradually from three hours at the beginning, down to one hour.—*Das Buch fuer Alle.*

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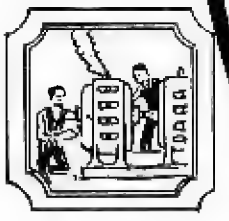

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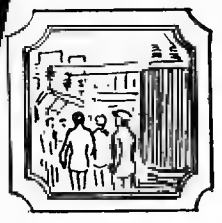

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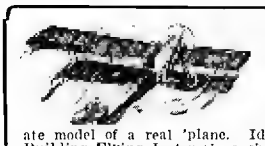

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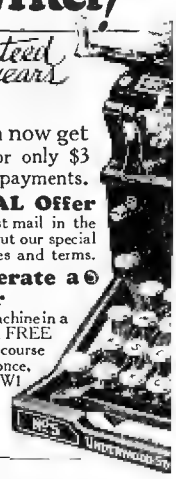

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The Dynamo Terror

By CHARLES MAGEE ADAMS

(*Continued from page* 134)

ney's face darkened with disappointment. The storm had failed. His opportunity was fading.

Then, as if the elements had merely been gathering strength for a supreme effort, a leaping flame filled the sky. There was a crash from the breakers, and on its heels, the vicious clang of thunder.

Jerry groaned. "I'm in for it now."

Rodney had swung about abruptly taut, and was peering into the switchboard gallery, eyes bright and expectant. Whole rows of green lights flashed along the panels. The alarm bell pealed ceaselessly, and the operators, even Warner, jabbed frantically at control buttons. The main breakers were tripped. Another moment would put those inexorable steel and copper tyrants at his mercy, and he would show them none.

He was starting through the door, exultant with the imminence of victory, when a telephone on the chief's desk jangled—the one connected to the city lines. He turned back and picked up the receiver.

"Yes. Kirkwood? Wait. I'll call the chief."

He ran into the long, glass-walled room, shouting at Warner above the mingled tumult of storm and plant. But Warner merely turned a drawn face and shook his head. The green lights were fewer, replaced by red, fitfully yet persistently.

"But it got Kirkwood," Rodney repeated, resentment and chagrin cropping out in his voice. They had closed the main breakers, cheated him of his victory. The red lights were holding, save for a single block of green, and he tugged at the big man's sleeve impatiently.

Warner submitted at length; at the telephone, listened while Rodney stood by frowning; and without a word, hung up the receiver.

"The Kirkwood substation's gone," he stated, slowly, turning.

"Well?" Rodney's tone was curt. Victory in his very grasp, only to be snatched away by these men who knew nothing but unquestioning obedience to steel and copper.

"Gone," Warner repeated heavily. "A direct hit. It was the people at the factory next-door." He was straightening, as if under a heavy load. "But it might have been worse. For a minute I thought we were paralyzed."

"Get your men," he had turned to Jerry, purpose gathering in his eyes, "and rig up a new one. We've got enough transformers and switches for something temporary."

Rodney's frown darkened. Here it was again—the old abject solicitude for the welfare of machinery, regardless of what it cost mere men. He was turning away, stinging with resentment, when something about Markley caught him.

The boss lineman was still slumped wearily in his chair, but his head had come up, and rebellion showed in his blue eyes. "Nothing doing, chief."

Even Rodney was taken a little aback, and Warner was shocked into amazement. "What?" he managed, after a moment.

Jerry flung his cigarette at the cuspidor with a thud, straightened, and tilted his head defiantly. "I said nothing doing. I've stood for being tied hand and foot to a lot of transformers and high-tension lines just about long enough." There was bitter intensity in his voice. "This's the last straw! I'm through!" He was getting to his feet, quivering a little. "Find somebody else to wait on your damned system."

He shot a triumphant glance at Rodney and strode out the door, a touch of swagger to his shoulders. Warner stared after him bewilderedly; and Rodney felt a sudden pang of pity. This was a mere gesture—defiance that was in reality surrender. But he—

Rodney became aware that Warner's attention was focusing on him, purpose blotting the blankness from his face. "Then you do it"

Rodney's eyebrows went up. "Build a new substation?"

The chief nodded. "You can do it." He was leaning forward. "Somebody has to."

Rodney regarded him an instant, lines of rebellion like Jerry's coming out about his mouth; then nodded. "All right."

For a moment he had the sense of slipping; that he, too, was submitting because it was easier than resisting. But the next he was telling himself defiantly this was not surrender; that he was submitting merely because he chose to, so he still might master those tyrants that strove to master him.

"Those insulators won't do," he rasped, jabbing at the porcelain supports of the incoming wires, and turning to one of the linemen. "They're only for thirty-three thousand, and we've got to handle sixty-six. Those relays'll never stand up either." He pointed to the temporary control panel. "I ordered them out at Vista three months ago."

The lineman nodded over the rim of his cup, with sodden indifference. "That's what they sent us, and its all they've got."

Rodney glared; then checked himself, saw. This thrown-together makeshift would not suffice. There would be a short-circuit—a short that could not be cleared—when the station was put on the line, and paralysis. A mere question of time.

Habit whispered Warner should be told; that catastrophe should be averted. But he silenced it. Nothing must come between him and victory, given into his hands now.

Warner came to meet him as he reached the switchboard gallery, feet uncertainly wooden. "Good boy, Rodney!" The chief's strained face was alight with pride and affection. "We just cut it in. As fine a piece of work as was ever done!"

Rodney merely nodded and glanced about. The signal lights were burning red and serene. From below came the ceaseless drone of the units, smothering every lesser thing under their implacable domination. But not for long. He was starting toward a chair to wait when the chief took a letter from his pocket.

"They want you at Allegheny, Rodney. This came yesterday." He was beaming, seemed not to notice Rodney was watching the signal lights, dark-circled eyes narrowed and impatient. "I'll hate to lose you, but I'm mighty glad for you, especially after what you've just done. It means—"

A crash from overhead cut him short; not the accustomed circuit-breaker staccato—a shattering hammer-blow that seemed to jar even the turbines out of their eternal hum.

He whirled to the switchboard, face instantly tight; and Rodney swung about, tense. The operators were there, bent over a winking line of green that spread from end to end of the orderly panels, hands reaching for control buttons; and the chief halted stricken.

"Kirkwood!" he gasped hoarsely. "The main breakers!"

Rodney's weary shoulders straightened exultantly. He was in time. His moment had come.

The alarm bell was pealing frantically. The operators, Warner between them, were jabbing furiously, and the long line of green

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changed to red; but only for an instant. There was another shattering detonation; a leaping line of green; more packed seconds of jabbing, swifter, desperate; a flash of red; another rending crash; and green again!

Rodney could not stand still. He was quivering, giddy with the intoxication of victory. Seconds now, and those inexorable masses of steel and copper would be conquered, beaten.

The chief turbine operator and boiler room foreman had burst into the room, faces white. "The auxiliaries are stopping!" they shouted shrilly. "The auxiliaries!"

Warner was staggering back from the mocking line of green, sweat streaming down a gray face. "It's no use," he choked brokenly. "We can't clear it."

"But, chief!" The boiler room foreman had him by the shoulder. "They're stopping, I tell you. Pumps! Fans! Everything!"

Warner only shook his head with beaten helplessness. "We're paralyzed," he surrendered huskily.

The inexorable hum of the turbines had not slacked, but the shrill overtone of pumps and motor-generators, the deeper drone of fans and stokers was lacking; and a hurt, laboring note had crept in. They were losing; those arrogant, implacable bulks at last mastered.

Rodney turned to the chief. "We couldn't insulate right, and the relays were shot." It was as well to make it clear he had not planned this.

Warner nodded with weary patience. "It's not your fault." He was turning heavily to the panels. "We'll have to shut down."

He pushed control buttons, and the hum from below dipped; yielded to that hurt, laboring note. Rodney began his tense pacing up and down again. Victory! The drone of the big units was dropping—slowly, stubbornly, as if they were fighting with all their steel and copper might, but steadily lower and lower, down a long slope of sound, while that hurt, laboring note swelled; and he had it in his power to save them.

Dick Brinker came running through the door to the turbine room. "Start 'em up again! Do you hear?" His face was drawn, washed-out eyes appalled. "I can't stand it!"

Rodney halted and eyed him with wry pity. Tied hand and foot to the last—not even glad to be free when the chance came.

Warner turned to the little operator with helpless patience. "But, Dick, we're paralyzed."

Rodney tingled. They were asking for help now—those roaring, arrogant bulks; beseeching, begging for it, after all their ruthless domination, their implacable tyranny; and he could give it, but he would not. The taste of victory was sweet.

He laughed. But somehow it sounded hollow; and his chin set, shoulders squared defiantly. Let them call. He was not their servant. He was their master.

Rodney tried in a panic of will to hold his face stern, shoulders defiant. But the exultation was going out of him. He was limp, quivering, and the dying pull of those steel and copper bulks was tugging at him with a tightening, irresistible clutch. He felt himself turning under it; struggled to stop; but the next moment was facing Warner.

"Start 'em with trucks."

"Trucks?" The chief gazed at him blankly.

"Trucks. Electric trucks." Rodney's monotone was dull, lifeless. "Use their batteries to feed the auxiliaries."

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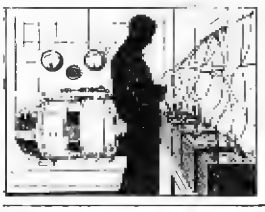

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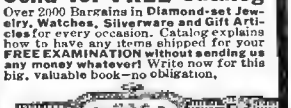

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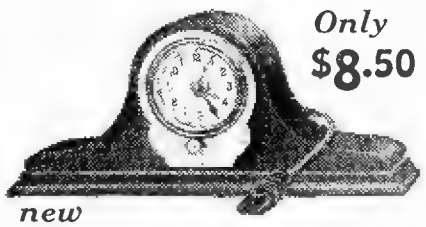

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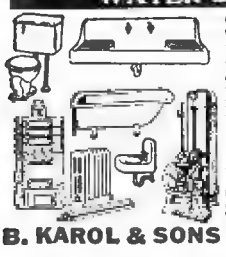

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He straightened stiffly from an open junction box where a cable ended, looked out at the line of squat trucks in the morning sunshine, then up at the chief operator in the switchboard gallery, and swung an arm clumsily.

A sound added itself to the faint hiss of pop valves that broke the pall of stillness—the high-pitched murmur of feedwater pumps; then another, the gathering drone of draught fans, joined a moment later by the quivering hum of circulating pumps far beneath. Dick Brinker, at No. 2, was bending to the throttle. There was a hiss, a groan, a rumble. Other operators were bending to throttles—No. 3, No. 4, No. 1. Groans and rumbles swelled, blended. The old teeming bedlam was filling the room once more—roar of turbines, shrill whine of exciters, the pulsing sixty-cycle hum of generators.

Rodney slumped heavily against the wall beside the junction box, black-circled eyes closed, and grimy hands dangling. It was all over. They were the masters again, those whirling juggernauts of steel and copper—complete, undisputed masters now, and he their beaten, unresisting servant.

Their smothering din closed in on him, broke over him with a mounting irresistible wave, and he bowed his head. Conquered, when he had set out to conquer them; doomed to a subjection as abjectly hopeless as Dick Brinker's and John Warner's with mastery in his very grasp. He slumped lower, wearily. Nothing ahead but more submission, more galling servitude.

Then he became aware slowly, that the engulfing bedlam was not hemming him in; not pressing him down under an implacable tyranny. He raised his head, looked about with numb wonder. All four units were running. He could see Dick Brinker looking across at him, a new comradeship in that steady devoted servant look. Yet the encompassing din flowed over him and through him, bathing him soothingly, gratefully, in the full blended harmony of a great symphony.

His sagging figure straightened, and he took a deep, gulping breath. He was not their servant. He was part of them, part of their pulsing, vibrant might—a part they welcomed, were drawing to themselves, giving him a full, ungrudging share in their splendid power.

"Rodney."

He turned to face John Warner.

"I want you to know how proud—"

Rodney checked him, a hand on his arm. "Just a minute, chief." His shoulders were squared: his head up, high, steady; a clear kindling serenity shining through the dirt and stubble of his face. "I've got a confession to make. I knew Kirkwood would paralyze us." He was unflinching. "I had this truck trick worked out all the time, too, and didn't tell you because I wanted to lick them—be bigger than they are. But they got me, and chief," his eyes were glowing with that kindling serenity, "it's good, isn't it? Good to know you really belong to them. If you'll forgive me, I'll take that Allegheny job—any job that gives me a chance to be part of something bigger than I am."

"Forgive you?" Warner's gray eyes were alight, and the grip of his broad hand was warm. "It's something we've all got to go through, Rodney; and I knew you'd see."

His eyes twinkled quietly. "There's a girl from the cashier's office waiting for you upstairs. I told her you were dirty and needed a shave. But she said she didn't care."

THE END.

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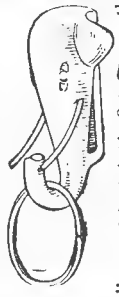

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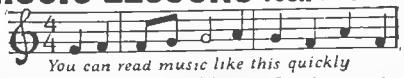

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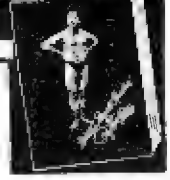

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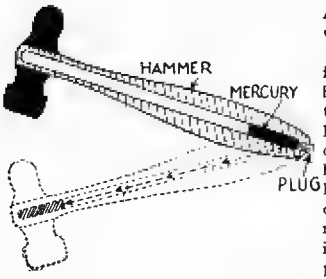
Hints for the Mechanic

(*Continued from page* 147)

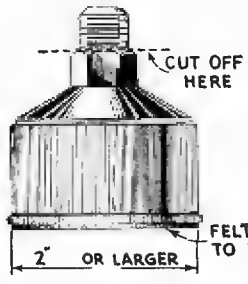
WHIRLWIND HAMMER



A hammer which adds gyroscopic force to the blow is illustrated at the left. The handle of the hammer is hollow and a quantity of mercury is introduced. A plug at the end of the handle prevents the mercury from escaping and also provides a means for adding more mercury. As the hammer is swung the mercury runs to the end of the handle and increases the driving power.—Charles D. Brooks.

GLUE POT

A large discarded grease cup with the threads removed makes a very handy mucilage or glue container. The weight of the cup prevents it from being easily tipped over. A cork or combination brush and cork should be inserted in the opening at the top. In order to prevent marring the office furniture a strip of felt may be glued to the bottom of the cup. A grease cup of two inches in diameter or larger should be of convenient size to use for ordinary purposes. —Joseph A Bieke.



Television Perfected at Last

By H. WINFIELD SECOR

(*Continued from page* 109)

uring 2 by 3 ft. This glass tubing was first exhausted and filled with neon gas, which glows with an orange color each time an electric current passes through it. On the rear surface of the various horizontal tubes of this glass grid, there were cemented 2500 tin-foil segments. Each tin-foil segment connected by means of a wire to a contact on a special stationary commutator. Inside of this commutator containing the necessary 2500 metal segments, a contact arm revolved, this arm being fastened to the same shaft with the two synchronous motors, as described previously.

As will become evident, the larger the screen on which the living image is to be built up and reproduced with all the smiles and bows, etcetera, the greater the number of light pulses or spots one must use. So we see that instead of having a small picture of Mr. Hoover before us measuring 2 by 2½ inches, as in the case of the small machine previously described, we will have to use a proportionately greater number of light pulses with the large 2 by 3 ft. screen. It almost staggers one to consider for a moment that this large screen required, so the engineers decided, 45,000 constantly changing light pulses per second!

The way in which this was worked out represents a clever bit of engineering. For each light target that sweeps across the object at the transmitting station, one horizontal leg of the glass tube screen with 50 tin-foil segments, is illuminated from end to end. Every second the 2500 tin-foil segments on this large screen are energized eighteen times by the revolving commutator arm and its associated wire connections, so that 900 times 50, or 45,000, light pulses flash over the screen each second. In other words, every time one light pulse sweeps across the object at the transmitter, the commutator arm used with the large screen has moved over 50 segments. Not only this, but it is interesting to note that as the commutator arm moves over the 50 segments, and 50 light images flash across one leg of the glass screen tube, these light pulsations are graduated in tone corresponding to the various tone values on the surface of the object, such as the hair and skin of a human face.

Referring to Fig. 2 for the moment, it should be noted that the wires coming from the vacuum tube amplifier at the terminus of the image transmitting circuit, are connected respectively to the commutator arm, and to the common terminal in the end of the glass grid tube making up the large screen. In this way, and with proper amplification of several hundred volts, each incoming impulse from the image transmitting circuit, causes a glow opposite the respective tin-foil segments in the tube, the current passing through the neon gas and illuminating it.

What the future application of this television apparatus will be is very difficult to say. The offhand impression seems to be that we shall all have television screens on our telephones before long, but as Mr. H. Gernsback has pointed out in his editorial, things may take a different turn and a brand new application of the perfected television apparatus may flash in front of us, as unexpectedly indeed as did this demonstration and introduction of the perfected living image transmitter and receiver.

Our Spiritualistic Investigations

By DUNNINGER

(*Continued from page* 138)

two who had departed and he would try to secure messages from them to me. I mentioned the names of Edward and Elizabeth. The master of the psychic asked me to explain the relationship of these people to me. It was plain to see that he was stalling for time, the reason for which I could not at the moment explain. My eyes were affixed firmly upon the slates, still in full view, but nothing happened. He did not touch them in any way, nor were they moved in any fashion. The medium now proceeded to bring the slates forward, and place them face to face, so that my signatures were exposed, and requested me to tie them together with my own pocket handkerchief. This I proceeded to do, and as I watched his fingers closely during this entire operation, I was quite assured that his movements were natural, and the slates were in no way tampered with. The tall slim-fingered wonderworker asked me to place the slates upon my lap, and place my finger tips upon them. He uttered a well-practiced prayer, and after several moments, I was requested to untie the slates. There, upon the interior of one was written the following message . . . . "I am extremely happy where I am. Everything is lovely here. Elizabeth." "This world is beautiful. I, too, am happy. Edward."

(*Continued on page* 181)

YOU Can Set the Pace

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Now Take a Look At Yourself

You see what's happening to young fellows who saw no limit to life—who had "vitality to burn"! They're slumping — they're slipping —they're despondent. Read the papers. Ask yourself what is at the bottom of these frequent cases of despondency. If the truth were told, you'd learn that these poor devils had laid the foundation for their tragedy in their youth. Added excesses—speed, carousing, boozing, doping, associating with degenerates—piled up a burden Nature could not stand for—collapse followed.

ARE YOU GOING TO GO ON until you find yourself in the same physically broken condition? Are you going to keep on tapping the reservoir of energy Nature gave you? Don't do it, boy. I sound this warning as a friend, a protector. I have seen so many go down to physical and mental disaster that I must warn you to stop right where you are—NOW.

Heed the Danger Signals

You're tearing down a whole lot faster than you are building up and the longer you keep going as you have the worse you're going to get. Now is the time to take yourself in hand—before it's too late. And you can do it.

STRONGFORTISM will show you how, but you must act now. Each day you wait, each day you delay makes it just that much harder to bring you back. Let **STRONGFORTISM** help you. Let it restore in you those vital powers that you know you are losing and losing fast. It will rid you of annoying ailments, banish constipation, eradicate catarrh, bring down high blood pressure, do away with nervousness and lassitude.

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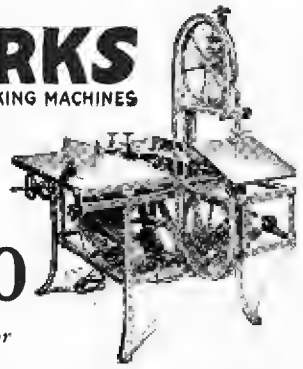

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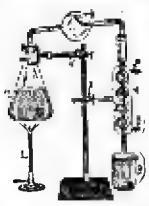

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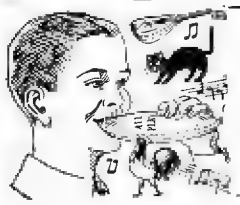

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Mars--the Mystery Planet

By W. J. LUYTEN

(*Continued from page* 124)

even estimates their distance to the planet and their periods of revolution, remarking on the fact that they conform to Kepler's and Newton's laws of planetary motion, and concludes that gravitation must therefore be the same at that distance as it is here.

Owing to its small weight, the planet Mars does not attract things as heavily as the Earth; on the surface of Mars a man, weighing 150 pounds on Earth, would register no more than 60 pounds.

This rapid and brief survey completes more or less those indisputable facts we know about Mars; when it comes to the geography of the Martian surface and the physical conditions on it we are on less firm ground, although recent researches have taught us a great deal about those things.

First, of course we come to the famous "canals" first seen by Schiaparelli in 1881, and called "canali" in Italian, simply to indicate that they were black markings of a straight-line character, channels. Later on, many more of these canals were observed, and especially by the late Percival Lowell, observing at Flagstaff, Ariz., who was convinced that the Martian surface was a perfect maze of them. And naturally, when these canals, some as wide as fifty miles and as long as two and three thousand miles were seen all over the planet, and were even seen to change in color and shape it was inevitable that they should be interpreted as the work of intelligent beings.

A bitter controversy resulted between the canalists and the anti-canalists, with the scene of battle and the methods of fighting continually shifting on account of the ever increasing accuracy of observation. But, the idea took root among some popular writers of great imagination, and it has remained a topic of perpetual disagreement between the astronomer and the semi-scientific fiction writer ever since. More ink has been spilled on this subject than on all other astronomical subjects combined. Schiaparelli seems to have felt that his observations might lead to such consequences. Before beginning to discuss the more speculative side of his observations, therefore, he said by way of preface that one "is allowed to talk foolishness twice a year." Unfortunately this period of immunity has lasted ever since.

Professor W. H. Pickering, who has devoted a lifetime to the study of Mars first advanced the theory that the canals as we saw them were not real canals, full of water, but strips of vegetation along much narrower, artificial canals. Percival Lowell obtained a great many converts to this theory, one of them, a hydraulic engineer who figured out that a pumping system sufficient to maintain such a vast planetary circulation of water, would require a constant expenditure of about 4,000 times the power of Niagara! Several other explanations put forth to explain the canals also met with little lasting success.

The latest ideas are that perhaps the canals do not contain water but are merely parts of the Martian desert moistened by rain-clouds hovering over them. For, recent observations have shown that there is little or no water on the Martian surface: it is all arid land void of what for us is one of the first essentials of life. True, we have known for a long time the existence of the "Polar Caps," extremely brilliant white spots around the poles of Mars, which become smaller and smaller as the season advances from winter, through spring to summer.

One explanation is obvious: the caps are the polar masses of ice and snow that melt in spring. For a short time this explanation

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was questioned because of the low temperature, and the alternative advanced that it might be frozen carbon dioxide; the recent observations of temperature, however, have shown that in all probability it is water, ice and snow, since the temperature is too high for frozen carbon dioxide. On the other hand, observations made on high mountains in California, where terrestrial influences are minimized, indicate that there is little or no water vapor on Mars. On the other hand again, other observations indicate the presence of an atmosphere of some sort some 100 miles thick, which may be the cause of the orange hue which Mars seems to have. Support to this theory is lent by the fact that observations of the south polar cap made in red and blue light, indicate that the polar cap may be very largely an atmospheric phenomenon, high up above the Martian surface.

As for the vegetation on the surface of the planet, it is an undisputed fact that the color of the surface changes from greenish to brown, as the seasons advance and summer passes. Observations made with the spectroscope have so far failed to show the presence of any chlorophyl (leafgreen) such as we have on earth, but it is generally admitted that these observations are so delicate that we cannot very well expect a positive answer from the means at present at our disposal.

Probably the most deciding factor in the controversy about life on Mars is the temperature. Life such as we know it on earth cannot exist under extreme conditions of temperature. Recent observations made at the Lowell and Mt. Wilson observatories have shown conclusively that the general run of temperature of Mars, although lower than on earth, is not radically different from ours. For the polar caps these observations have given a temperature of 90 degrees below zero (which is not much lower than the coldest spot on earth). Near the equator, at sunrise and sunset, the temperature is about 9 degrees above; while at the center of the disk, where the sun is straight overhead, the temperature may rise to 80 or even 100 degrees Fahrenheit.

With all these uncertainties still existing in practically all the important points, we cannot say anything very definite about the possibilities of Martian life, and the best we can do is to review the conditions to be fulfilled before life similar to ours can become possible on Mars. Although, as mentioned before, the force of gravity at the surface is only two-fifths of what it is here, it is yet enough to retain the principal gases of the atmosphere, and probably large enough to retain even water vapor at low temperature. Other prerequisites of life are that the planet must not be too far away from the sun, nor too near to it, in order that liquid water may exist on its surface. The orbit must not be too elliptical, and the planet must rotate with such a speed that day and night do not present too much difference in temperature. For similar reasons the rotation axis must not deviate too much from the perpendicular to the orbital plane. All these conditions are just met by Mars, but no more than that. If therefore life exists on Mars it must be under severe conditions and cannot be compared to the easy existence on our Earth.

Finally: what about the radio signals? For some time past the newspapers have carried accounts of trials that were to have been made to receive radio messages from Mars, were these really sent out. The scientists will probably pay very little attention to this. If, indeed Mars harbors a population of beings whose intelligence is comparable to our own, and whose technical achievement is also comparable to ours, then it might not be improbable that they would desire to get in touch with us by radio signalling. Yet they may be only listening in, just as we are, without themselves taking the initiative to send any signals.

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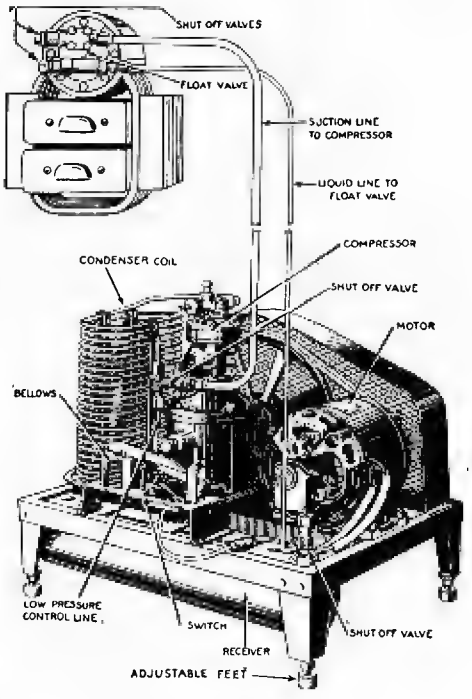

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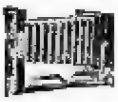

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Rules for Matchcraft Contest

(*Continued from page* 130)

$100.00 Monthly Prize "Matchcraft" Contest

DURING the past year SCIENCE AND INVENTION Magazine awarded $5000.00 for articles made entirely of matches. While this $5000.00 contest has officially expired, the publishers have decided that because of the great popularity in Matchcraft constructions, the contest would continue in force on a new prize rate basis until further notice. The list of new prizes will be found in the center box and the same rules for the first contest are to be observed in this contest.

(1) Models submitted must contain at least 90 per cent. safety matches in their construction.

(2) Models made of toothpicks, paper matches, or non-safety matches, are not eligible in this contest.

(3) Models can not be built around boxes or other supporting articles. Walls, roofs, etc., must all be self-supporting and made of matches.

(4) All liquid adhesives, such as glue, shellac, cements, etc., are permissible.

(5) Models may be painted, gilded or silvered.

(6) Models may be of any size.

(7) In order to win a prize, it is necessary that either models be submitted, or, if this is not practical, owing to their size, a 5"x7" photograph of the model may be sent in lieu of the model itself. The best models submitted each month will be awarded the prizes scheduled herewith.

(8) All models submitted to SCIENCE AND INVENTION Magazine will be promptly returned to the builder, who will prepay all charges.

PRIZE AWARDS

First Prize	$50.00
Second Prize	20.00
Third Prize	15.00
Fourth Prize	10.00
Fifth Prize	5.00
Total	$100.00

(9) Where SCIENCE AND INVENTION has any doubts as to the model (where photos only are submitted) complying with all the regulations, the judges may, at their discretion, require that the actual model be sent in for inspection, paying transportation charges both ways.

(10) This is a monthly contest and will continue until further notice. Each monthly contest closes on the first of the month following date of issue. Thus the contest for the month of May will close June 1st and prize-winning announcements will be made in the August, 1927 issue.

(11) Models must be shipped in a strong wooden box, never in a cardboard box, as SCIENCE AND INVENTION can not be held responsible for breakage in transit due to models having been improperly packed.

(12) When models are sent, be sure to affix tag, giving your name and address, to the model itself. In addition, put name and address on outside wrapper of package.

(13) Address all letters, packages, etc., to Editor, "Matchcraft" Contest, care SCIENCE AND INVENTION Magazine, 230 Fifth Ave., New York.

Caution—Soak or cut heads from matches before building your model so that the models may be expressed or mailed. The strike-everywhere square cut Liberty matches can be used if the heads are cut off.

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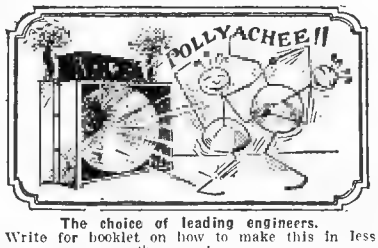

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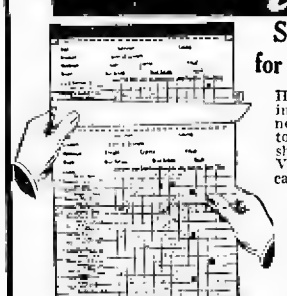

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Our Spiritualistic Investigations

(*Continued from page* 177)

Upon my way home, I wondered which of the two was most deserving of the $25 I paid for this exhibition. The silver-tongued medium, or his dwarf hunch-back assistant, who, had all this time been secreted in the victrola. Hearing the names, Elizabeth and Edward, he lost no time in opening a small trap, in the top of the victrola, and wrote the spirit message upon the slates, which had been so innocently placed there.

Home Mechanics

By W. M. BUTTERFIELD

(*Continued from page* 136)

inches thick, 2 inches wide and 4 inches long. These blocks are screwed to the board section of the top (as shown at Figs. C, C), and in such a manner that the backs of the wings when extended will be 80° from the vertical, and the line of the backs vertical and sloping back when the wings are closed. The top edges of the braces are tapered from the line of their backs at an angle of 80° as shown in illustration.

Brace Stop and Catch: A wooden block and a brass catch are provided for each brace (see Figs. E, E). The stop block is 1½ inches thick, 1½ inches wide and 2 inches long. It is screwed to the falling section of the top as shown. The catch is 3/32 inch thick, 1¼ inches wide, and bent or shaped (as shown in Fig. E). Screw holes are made in the brass catch and it is screwed to the stop exactly as shown.

Top Fastening: In order to secure the board forming the outer center section of the top (Fig. C) to the frame of the table, a piece of 1½-inch lumber (Fig. G) is planed on a bevel to fit the inner opening at the top of the same frame. This wedge-shaped piece is provided with 10 holes for screws bored 2 inches from its four edges, and is then firmly glued in place as shown (Fig. G). The center fixed section of the table top is held by screws to this wedge-shaped piece.

Finishing: When the board section of the top has been secured with screws in the top fastening, and the brace blocks have been screwed firmly in place, take off the board and fasten the drop-leaves to the center part with the hinges (placing each hinge 3 inches from the outer edge). Then replace the board with its leaves, and the braces, and screw the stop blocks with their brass catches in place on the leaves. The edge of the top can then be finished. Whatever smoothing is necessary can now be done and the table is ready for priming.

Enameling: A coat of flat color, of the shade of enamel to be used, is first applied. When it is dry, crack filler, also tinted, is used, if necessary. Two coats of enamel are usually put on, with forty-eight to sixty hours between coats for drying. If decorations are used, the enamel must be thoroughly dry before they are put on.

Decorations: Decalcomania transfers are nearly always used on the butterfly table nowadays, mostly in floral designs. These can be obtained at the furniture supply houses, and are attached to the furniture in several ways. It is best to follow the directions accompanying them, although it is safe to varnish with transparent varnish all kinds when attached. Border designs are best for the top, with small sprays or vignettes for the brace spreaders on leg posts. Some tables are very highly ornamented, others only have a single wide border extending around the top.

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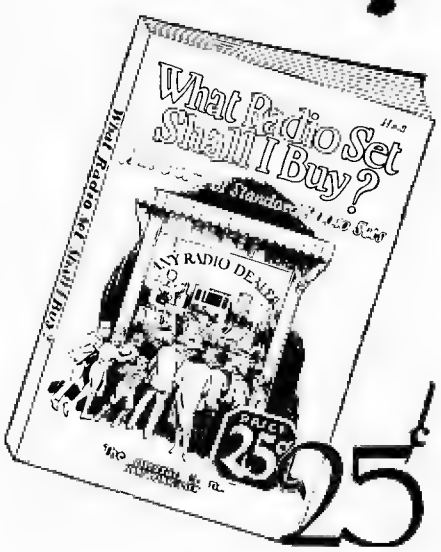

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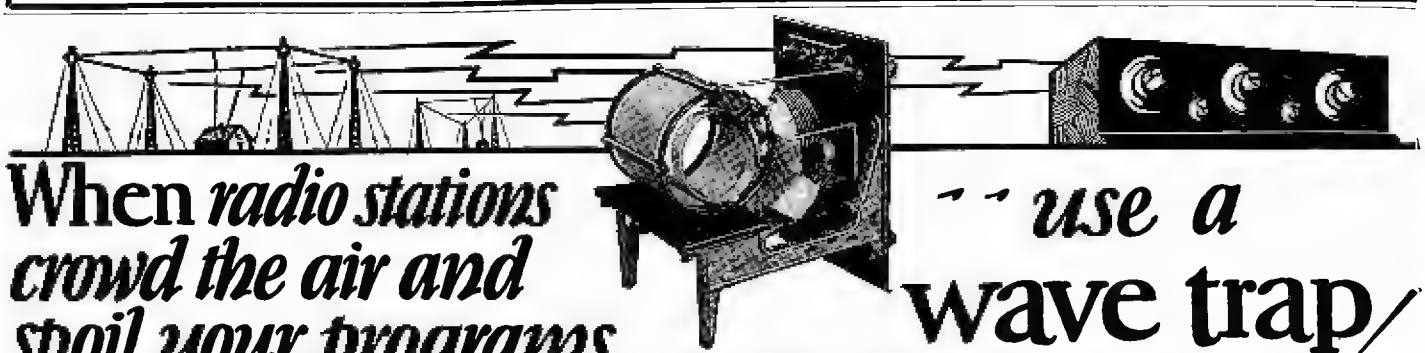

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ACCUMULATOR CHARGING, by W. S. Ibbetson. Stiff cloth covers 5"x7½", 33 illustrations, 116 pages. Published by Sir Isaac Pitman & Sons, New York. Price $1.00.

This book has been written for al types of users of storage batteries. The author has borne in mind throughout the work the actual requirements of both the amateur and the service man, and the knowledge gained by its perusal should be of immense profit to both. The book is essentially of a practical nature and gives in detail all the information necessary for keeping the battery fully charged and in good condition. This, however, is not enough for the reader who wishes to thoroughly understand his battery, so just that amount of theory has been included, treated in as simple and direct a method as possible, to enable the reader to understand the principles underlying the actions of the battery and its treatment.

THE STORY OF MATHEMATICS, by Denham Larrett. Stiff cloth covers, 5"x 7½", illustrated, 87 pages. Published by Greenberg, New York. Price $1.25.

The mere mention of the word mathematics usually conjures up visions of dreary textbooks and innumerable "sums" but there is more than technique in mathematics. There is a story also, and in this little book the author has tried to tell something of this story in a manner that should at least give a meaning of this inner side of the subject and at the same time spare the reader the terrors of symbols, formulae and other intricacies. In an era when applied science is entering more and more into his circle of interests, the ordinary man will realize the fundamental position of mathematics, and may well wish to gain some idea of its origin. Mr. Larrett's book provides for this desire in a very adequate and enjoyable way, and will no doubt stimulate a few to explore more deeply into a noble and fascinating subject.

AIRCRAFT INSTRUMENTS, by H. M. Eaton, A.M.; K. Hilding Beij, B.S.; William G. Brombacher, Ph.D.; W. Willard Frymoyer, B.S.; H. B. Hendrickson; C. L. Seward, B.S.; D. H. Strother, MS. Stiff cloth covers, 6"x8½", 69 illustrations, 269 pages. Published by the Ronald Press Company, New York. Price $5.00.

The writers have attempted to describe clearly the various aircraft instruments in general use, of both American and European manufacture, to explain the operating principles of each class and to discuss the errors to which each class of instrument is subject. The arrangement of the subject matter adapts the volume for use as a reference handbook. At the same time the illustrative problems and the presentation of the theory of the operation of the various instruments should make the volume suitable for use as a textbook. In particular the treatment of the theory of barometric altitude determination will be found useful in barometric leveling, as well as in aeronautics. The first Appendix contains physical and mathematical constants and conversion factors. The second Appendix gives suggested performance specifications for the more common instruments described. These, representing approximately the specifications used by the various governmental departments in purchasing aircraft instruments, should prove useful in connection with the purchasing of instruments for aircraft, for automobiles and for various other technical purposes, such as the storage of gases and liquids.

MATHEMATICAL AND PHYSICAL PAPERS, by Benjamin Osgood Pierce. Stiff cloth covers, 6¼"x9½", 444 pages, illustrated. Published by the Harvard University Press at Cambridge, Mass. Price $5.00.

In this volume are assembled practically all the papers which Prof. B. O. Peirce published in the last ten years of his life. The volume not only serves as a memorial to a distinguished scientist, but will be of practical value to all investigators in the fields of mathematics and physics. The volume deals mostly with the physical papers among which are a number on electricity. At the back of the book are four pages of Bibliography which will be found useful to the reader.

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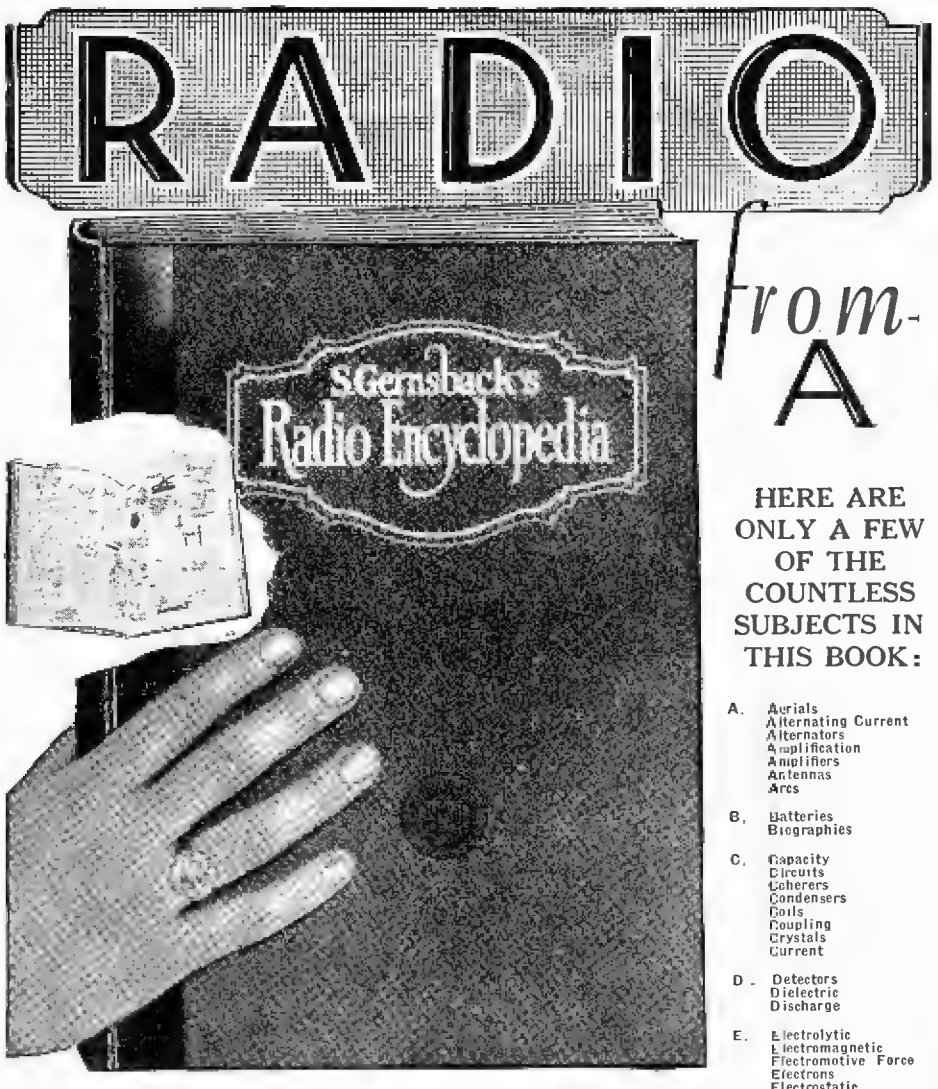

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S. Switches

T. Theory of Current Flow
Transformers
Transmission
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U. Units

V. Vacuum Tubes

W. Wave
Wires
Etc., etc.

to Z

WHAT EVOLUTION IS, by George Howard Parker. Stiff cloth covers, 4¾"x 7", 174 pages published by the Harvard University Press, Cambridge, Mass. Price $1.50.

Considering its size, this work on evolution is noteworthy. The subject is presented in clear, understandable language and it should interest both friends and foes of the evolutionary theory. The evidence of evolution explained from comparative anatomical structures, from the embryological viewpoint and from the standpoint of rudimentary organs is taken up in order, but unfortunately with insufficient thoroughness. This as previously stated is primarily due to the size of the book and does not in any way impair its value, except for the ardent evolutionist. Everyone should know what evolution is about and this book certainly presents the subject in a straightforward manner. We can heartily recommend it.

EVOLUTION FOR JOHN DOE, by Henshaw Ward. Stiff covers, 5¾" x 9", 342 pages. Published by the Bobbs-Merrill Co., Indianapolis, Indiana.

This book is a presentation of the adoption of evolution by a firm believer therein. There is little use in reading it to obtain any presentation of those who do not accept it as presented by this author. It is very nicely printed. It is especially to be noted that the paper is uncalendared, so as to spare the eyes of the reader. The author has a knack of making his subject very interesting, and whether we agree with him or not, much enjoyment will be derived from its perusion. A short bibliography is included in an index running largely into names, but curiously enough the name of Epicurus is omitted.

MEDICAL EDUCATION, by Abraham Flexner. Stiff cloth covers, 6¼"x9½", 334 pages. Published by the Macmillan Co., New York City. Price $2.50.

A complete history of the science of teaching medicine in the past fifteen years is found in this recommended volume. The average person has a very poor idea of the amount of time and energy required in obtaining an M. D. degree. For the sake of obtaining this knowledge alone, it will well repay the layman to browse over this survey of medical education with care. Those interested in education as a whole will find sufficient material in this volume to assist them in improving education along other lines aside from the medical.

SWOOPE'S LESSONS IN PRACTICAL ELECTRICITY, by Erich Hausmann, E. E., Sc. D. Stiff cloth covers, 5¼" x 8", 694 pages. Published by D. Van Nostrand Co., New York City. Price $2.50

The name of Swoope carries much weight with it on all subjects pertaining to electric power and electric engineering. This book, from the well-known house of Van Nostrand, while principally devoted to electric engineering with a treatment of the subject by elementary mathematics, in the latter part of the book goes beyond this and has a very interesting section on telegraphy and telephony, and a concluding chapter all too short but very excellently put on radio transmission. An excellent index gives a desired character to the book.

THE WILL-TEMPERAMENT AND ITS TESTING, by June E. Downey, Ph. D. Stiff cloth covers, 5¼" x 8", 332 pages. Published by World Book Co., Yonkers-on-Hudson, New York. Price $2.00.

"In his "Essay on Mankind," Alexander Pope says that the proper study of mankind is man. Some of us feel that of late years too much attention is being given to so-called psychology, but this book, as we turn over its pages, seems exceedingly interesting, practical, and as far as we have gone, is based on unsentimental facts. There are two indexes, one on authors, and one on subjects.

DAS NEUE UNIVERSUM, Vol 41. Stiff cloth covers, 6¼" x 9½", 472 pages. Published by Union Deutsche Verlagsgesellschaft, in Stuttgart, Berlin, Germany.

We always welcome the appearance on our desk of this quite delightful annual. It covers so large a field of subjects, and the subjects are given really without much order, that it makes a most attractive presentation of what has been done in the last twelve months, and its numerous illustrations, excellently presented add to its attractiveness. One compliment we can pay it is to say that we would like to see it translated into English for the benefit of those who are not familiar with the German language

(*Continued on page* 188)

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ADVANCE announcements

from JUNE ISSUE

Seeing in the Dark

Direct from London—a newly perfected system of transmitting the image of a person sitting in a dark room—television's latest achievement. The work of John Baird of London. It's one of the forerunners of practical everyday television—Get the facts from June RADIO NEWS.

The New Raytheon A-B-C Power Unit

RADIO NEWS is pleased to present complete details on the brand new Raytheon A-B-C Power Unit—that delivers "A," "B" and "C" power for your Radio, operating direct from the light socket. The dream of Radio Fans for a practical unit to replace all batteries is an actuality. See June RADIO NEWS.

The El-Phonic Capacity Pick-Up

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The Face That Vamped a Thousand Guys

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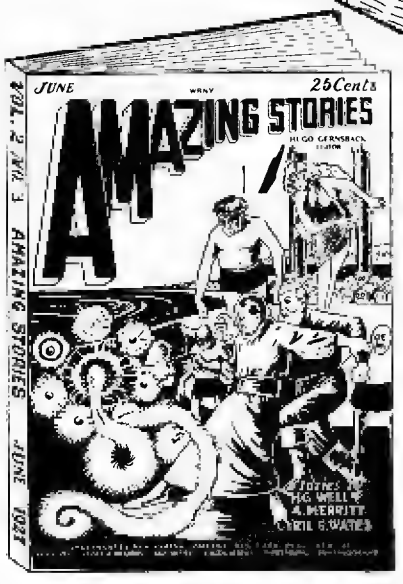

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This is the first prize story of our cover contest. Mr. Wates, the author, not only knows how to write interestingly and convincingly, but he also keeps your interest from beginning to end. Nor does he allow you to guess what it is all about until the end. The story not only is good fiction, but contains excellent science.

"The Visitation"

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Most of us have heard about comets, but very few of us have ever seen one. As is well known, there has been a great deal of superstition about comets in the past, and the most dire things have been predicted, when one of them approached the earth sufficiently near to become visible to the naked eye. The present story by our new author is excellent for any one who wants to brush up his knowledge of comets in general with a quantum of good fiction thrown in for good measure.

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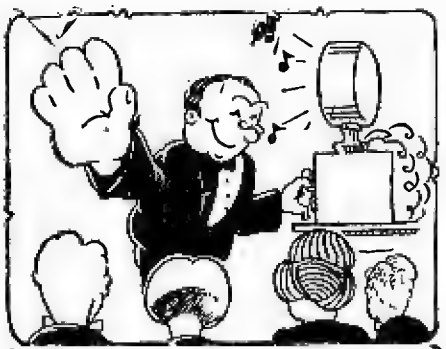

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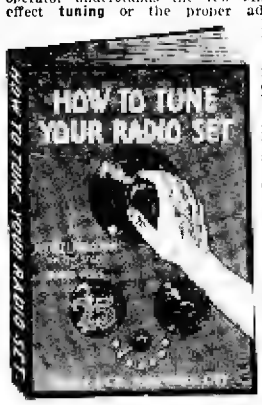

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Book Review

(*Continued from page* 186)

OUR ENVIRONMENT, HOW WE USE AND CONTROL IT, by Wood and Carpenter. Stiff cloth covers, 5" x 7", 704 pages, profusely illustrated. Published by Allyn and Bacon, New York City. Price $1.80.

Although this book on physics and on scientific problems of the day is primarily intended for the ninth year pupils, it is educational for the adolescent as well. It is written in popular style so well emblazoned with illustrations that it can be used as a general class reference hand book and can be made the subject of interesting debates, discussions, or theses. Some of the pictures are designed to develop the power of observation. Others help the student to appreciate the factors of his environment to form correct habits and to teach him the rudiments of science, beginning with the common articles found in everyday life to the more highly technical engineering fields. They further teach one the possibilities of science throughout the land, in every community, and in every home. Each chapter of the book contains a number of questions which the student should answer. These may be used by the instructor or instructress for verbal or written quizzes or they can be employed by the student himself to ascertain how much of the lesson he has learned. Many portions of this work are unique in conception and style. Thirty or forty key words serve to recall to the reader the facts about which he has read.

While "Our Environment" is not an elaborate treatise it is far more thorough than many books on natural science. Cuts and bruises, bread making, protecting the community, pollination, Mendel's laws, the sources of clothing, antitoxins, etc., wind up the work. We think, however, that a more appropriate title might have been chosen.

GREAT MOMENTS IN SCIENCE, by Marion Florence Lansing. Stiff cloth covers, 256 pages, 36 illustrations, size 5½" x 8¼", published by Doubleday, Page and Company, Garden City, New York. Price $2.50.

This book introduces to us the Pioneers in Science who have created our modern world. In it we meet them at the high moments of their achievement. Back of every invention or discovery there has been a man or a group of men, bold, adventurous, clever or interesting. In these pages we meet those men, some are familiar and some unfamiliar, but all are men to whom we owe a tremendous debt. Each group of stories, tracing some line of human thought, is brought to a focus in our present life. To read of these pioneers will make one appreciate our debt to them and will make young people more proud of their human inheritance when they see how the battles of science have been fought down through the ages by men and women like ourselves. The man, the place and period in which he lived, and the moment in which he won an immortal victory is the subject matter for the stories in this book. The author has given the reader a new outlook on science and one is carried by the romance and the glamour of science from the "Age of Fire" to the present day discoveries. To make this book helpful for handy reference a time table of the Great Moments in Science is included at the back.

EXPERIMENTAL SCIENCE, by J. G. Frewin. Stiff cloth covers, 5"x7½", 90 pages, profusely illustrated, published by the Oxford University Press, New York City, N. Y. Price $0.50.

During recent years the content of the schemes of work in school science has undergone considerable modification. The order of the main divisions of the book is unusual. The object the author has aimed at, before anything else, has been to interest the pupils in the subject, and the method adapted has been to avoid monotony by changing the type of work each term. The first 33 pages of the book are devoted to experimental elementary physics, the next 19 pages deal with experimental elementary chemistry and the last 18 pages comprise a series of experiments on elementary physics of the air.

HOW TO MAKE HIGH-PRESSURE TRANSFORMERS FOR RADIO AND POWER APPARATUS, by Prof. F. E. Austin. Stiff cloth covers, 5"x7½", 72 pages, illustrated, published by Prof. F. E. Austin, Hanover, N. H. Price $1.25.

The characteristic feature of this useful little volume is the large number of business-like examples of how transformers may be arranged, for given purposes, and their possibilities and limitations. A number of instructive curves are plotted and explained, showing the laws and variations of the different quantities. Brief but adequate space is devoted to principles and the use of the various constants employed in transformer work.

(*Continued on page* 190)

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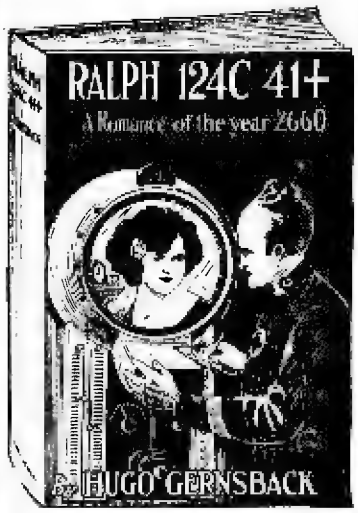

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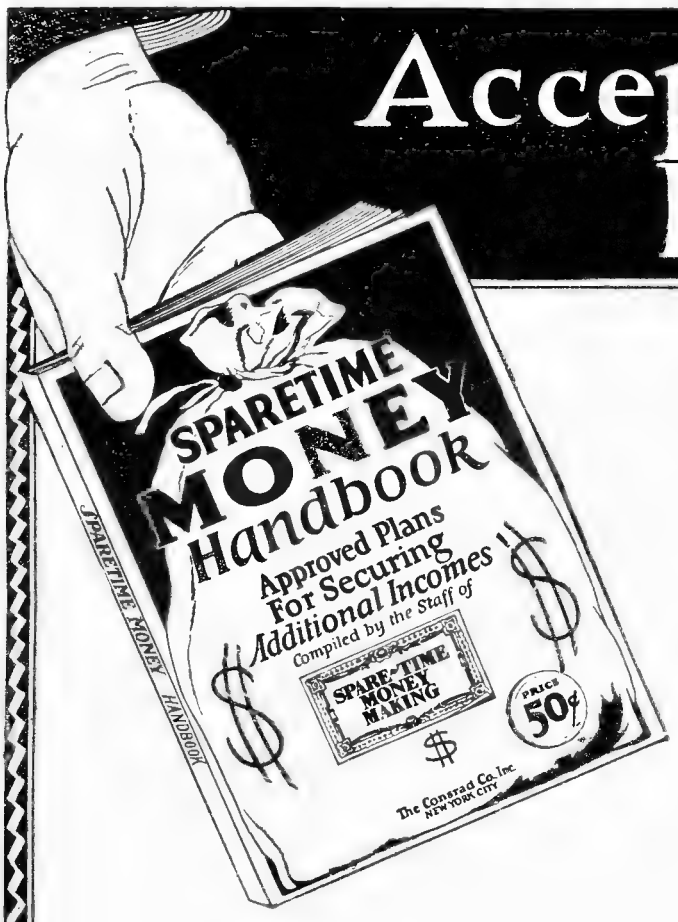
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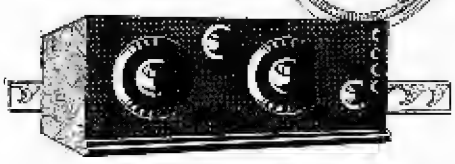

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Book Review

(*Continued from page* 188)

THE RADIO AMATEUR'S HANDBOOK, by A. Frederick Collins. Stiff cloth covers, 5"x7½", profusely illustrated, 404 pages, published by Thomas Y. Crowell Co., New York City, N. Y. Price $1.75.

This is a very complete, authentic and informative work on wireless telegraphy and telephony. Taking for granted that the reader is a novice the author fully explains the details of the simplest circuits, leading step by step into the deeper mysteries of complicated radio receiving and transmitting sets. An appendix of 12 pages of useful information, abbreviations of common terms, a glossary of 34 pages, 5 pages of insurance requirements and 26 pages of radio laws make this book indispensable to the amateur or radio fan. At the back of the book is given a list of radio books recommended for reading and list of dealers in radio apparatus and supplies.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of SCIENCE AND INVENTION, published monthly at New York, N. Y., for April 1, 1927.

State of New York } ss.
County of New York }

Before me, a NOTARY PUBLIC, in and for the State and county aforesaid, personally appeared HUGO GERNSBACK, who, having been duly sworn according to law, deposes and says that he is the EDITOR of SCIENCE AND INVENTION and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, THE EXPERIMENTER PUBLISHING CO., INC., 230 Fifth Avenue, New York, N. Y.

Editor, HUGO GERNSBACK, 230 Fifth Avenue, New York, N. Y.

Managing Editor, H. WINFIELD SECOR, 230 Fifth Avenue, New York, N. Y.

Business Manager, R. W. DeMOTT, 230 Fifth Avenue, New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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(Seal) HUGO GERNSBACK.

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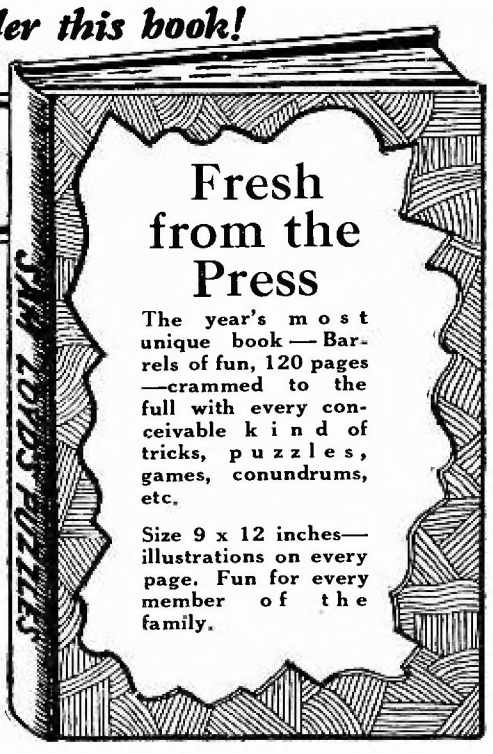
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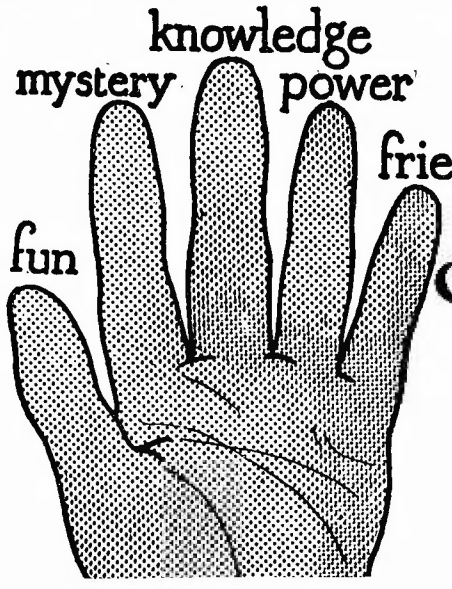

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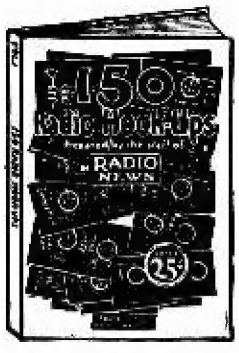

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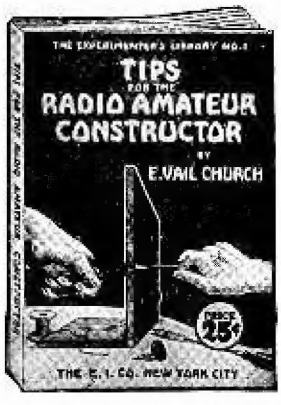

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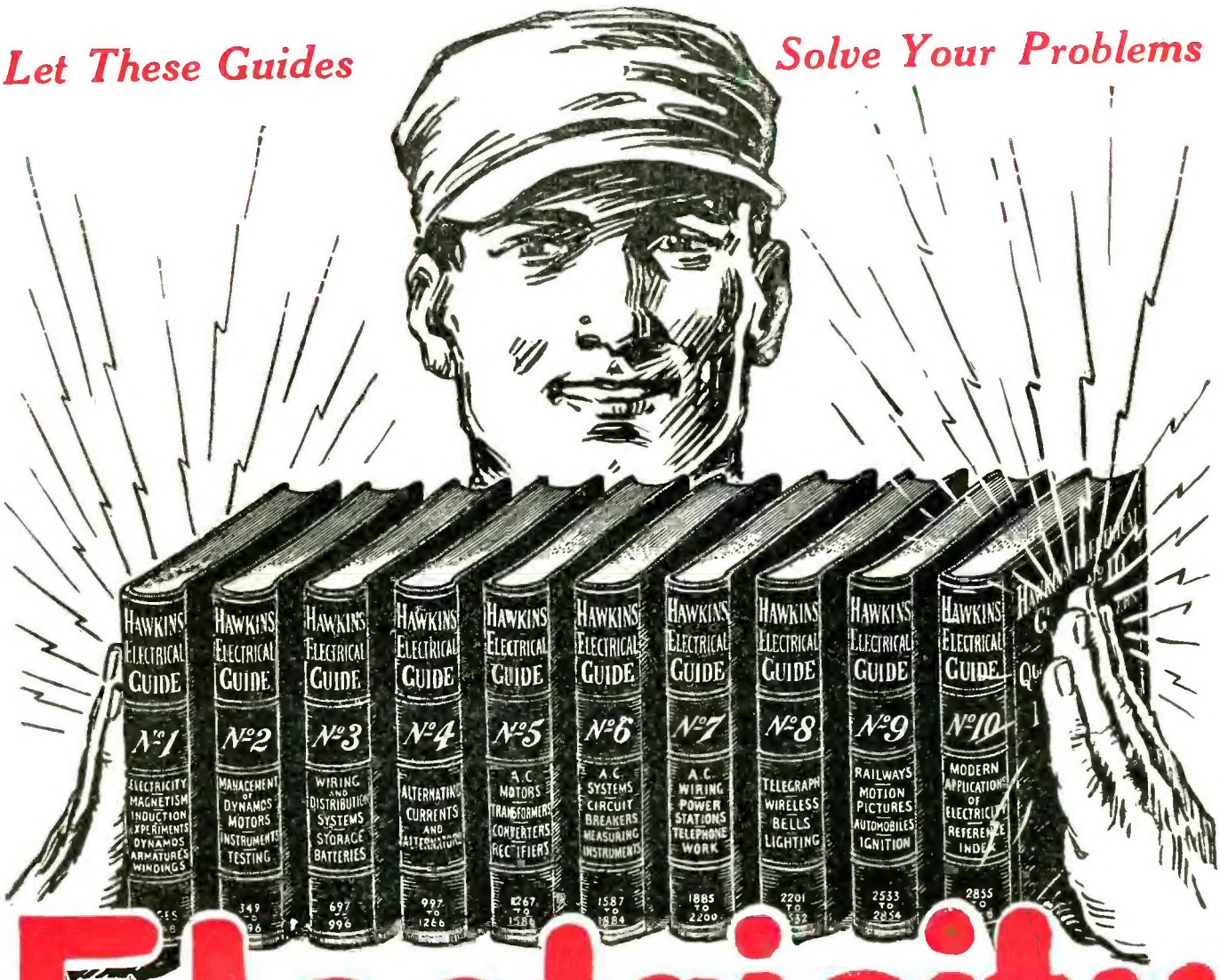

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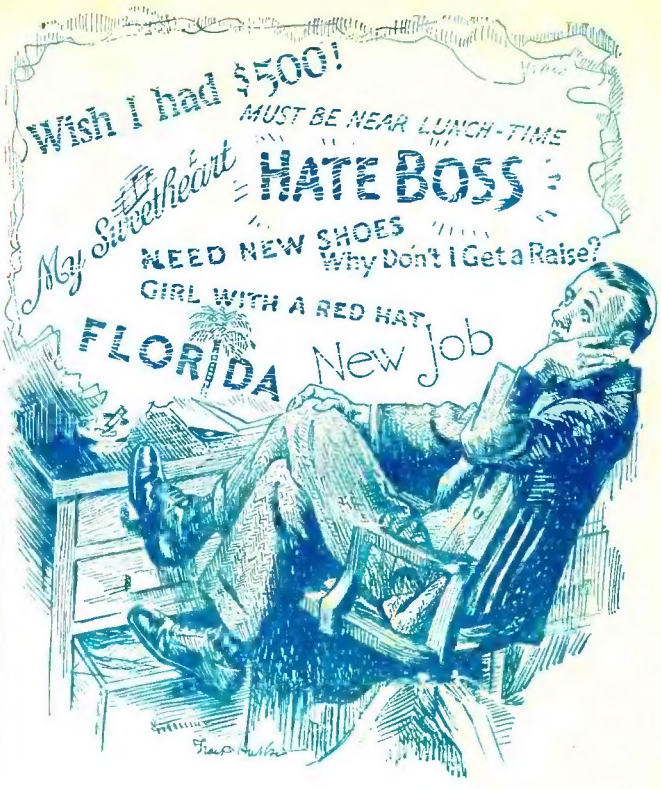

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